

Needs Assessment Study of Occupational and Health Hazards Faced by Desludging Workers in a City in India

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Abbreviations

BIS	Bureau of Indian Standards
CPHEEO	Central Public Health & Environmental Engineering Organization
CGWB	Central Ground Water Board
CPCB	Central Pollution Control Board
FSM	Fecal Sludge Management
MoUD	Ministry of Urban Development
NEBOSH	National Examination Board on Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
OSS	Occupational Safety Standards
OHS	Occupational Health and Safety
SLB	Service Level Benchmarks

1. Introduction/Overview

Safe collection, handling and transport of fecal sludge is an integral part of septage management. Limited attention has been paid to the safe collection, transport, disposal and treatment of human excreta from septic tanks. Motorised emptying and transport involves a truck with a standalone or mounted vacuum pump along with a storage tank that is used to empty and transport septage. Typically, these desludging trucks operate within the informal sector, so there is limited official data available on their numbers, operations, coverage and disposal practices. The general observations made were that the process of desludging has been carried out in the absence of any safety gear, putting the workers' health at risk, and the septage collected is dumped in drains, waterways, open land and agricultural fields, critically impacting the environment and public health. To gain a deeper and clearer understanding of the occupational practices of desludging and safety of workers, a study was undertaken in one city in India.

The objectives of the study were to:

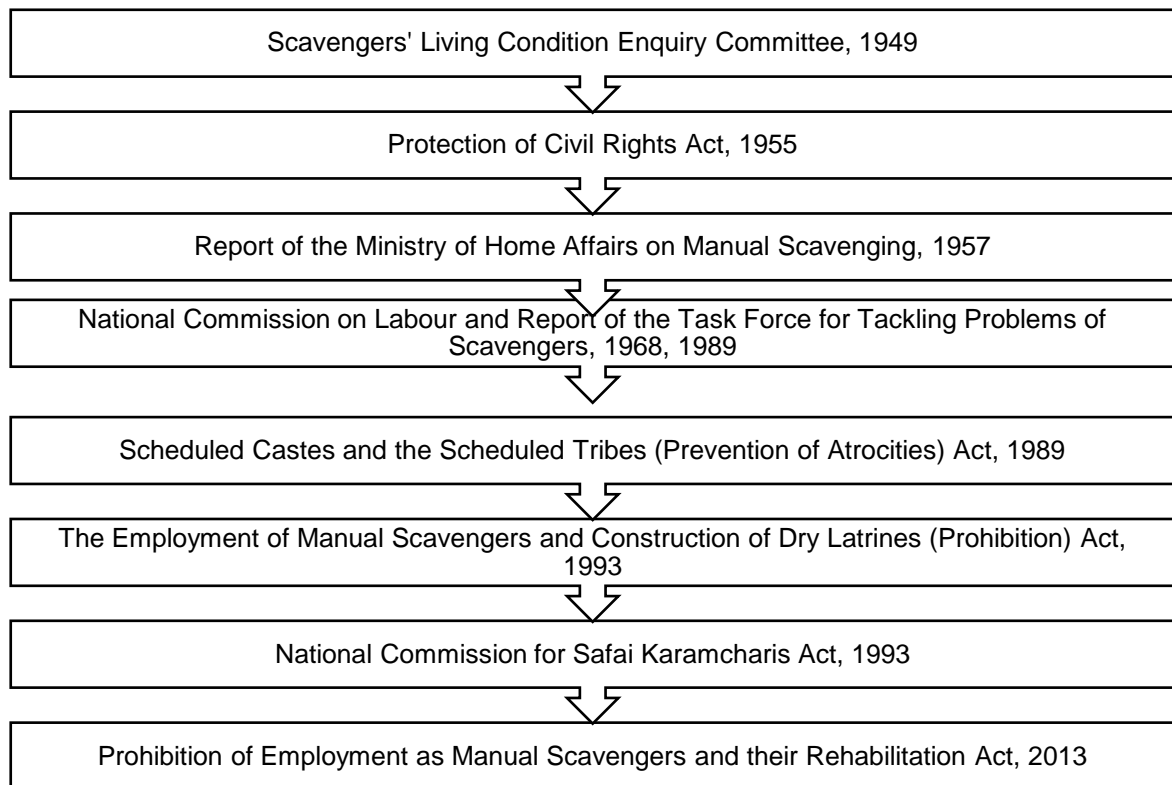
- Undertake in-depth analysis of current desludging practices (including measures for occupational safety) with an aim to understand resultant safety and health hazards for desludging workers
- Understand the underlying reasons (knowledge, behaviour etc.) for occupational practices and existence of hazards
- Understand the relevance and sufficiency of legally-mandated PPE and understand challenges for usage
- Develop a preliminary set of recommendations for improvement of OSSs

1.1. Review of Legal Framework

According to India's Manual Scavenging Prohibition Act 2013, manual scavenger means a person engaged or employed, for manually cleaning, carrying, disposing of, or otherwise handling in any manner, human excreta in an insanitary latrine or in an open drain or pit into which the human excreta from the insanitary latrines is disposed of¹. Further, the Act defines hazardous cleaning as the cleaning of sewers and septic tanks without utilising essential protective gear and cleaning devices.

Sanitation workers in general are exposed to high risk and in the absence of use of protective equipment are subject to biological, chemical, gas, environmental and mechanical hazards. In order to eliminate such hazards, employers are required to ensure safety control practices starting from engineering control practices to administrative controls and PPE. Preparedness to handle emergency situations with adequate provisions for rescue equipment and medical kits is also a necessity.

¹ It includes disposal of human excreta in railway track or in such other spaces or premises, as the Central Government or a State Government may notify, before the excreta fully decomposes in such manner as may be prescribed.



Source: IIHS Analysis, 2018

One of the first reports of the Scavengers' Living Conditions Enquiry Committee formed in the State of Bombay in 1949, stated that the carrying of night soil on head loads should be abolished. The Protection of Civil Rights Act (1955) made it an offense to compel any person to practice manual scavenging. In 1957, the report of the Ministry of Home Affairs on Manual Scavenging initiated provisioning of drinking and washing water along with supply of soap for scavengers and stressed the need for abolition of manual scavenging practices. Subsequently in 1968 and 1989, recommendations to eradicate the practice of manual scavenging were published by the National Commission on Labour and Report of the Task Force for Tackling Problems of Scavengers.

The Scheduled Castes and the Scheduled Tribes (Prevention of Atrocities) Act, 1989, came into force on 31 January, 1990. The main objective of the Act is to prevent offences or atrocities against the members of the Scheduled Castes and the Scheduled Tribes, to provide for Special Courts for the speedy trial of such offences, and for the relief and rehabilitation of the victims of such offences and for matters connected or incidental to it.

The Ministry of Urban Development (MoUD) issued The Employment of Manual Scavengers and Construction of Dry Latrines (Prohibition) Act, 1993, to abolish the twin evils of dry latrines and manual scavenging. The Act punished the employment of manual scavengers or the construction of dry latrines with imprisonment for up to one year and/or a fine of Rs 2,000. The National Commission for Safai Karamcharis² (NCSK) was constituted on 12 August, 1994 as a statutory body by an Act of Parliament viz. 'National Commission for Safai Karamcharis Act, 1993', for a period of three years. Its tenure has increased from time to time and performs the following duties as per Section 31(1) of the said Act:

² Safai Karamcharis is another term for Manual Scavengers

- To monitor the implementation of the 1993 Act.
- To inquire into complaints regarding contravention of the provisions of the Act, and to convey its findings to the concerned authorities with recommendations requiring further action.
- To advise the Central and the State Governments for effective implementation of the provisions of the Act.
- To take suo motu notice of matters relating to non-implementation of the Act.

1.1.1. Prohibition of Employment as Manual Scavengers and their Rehabilitation Act, 2013

The Prohibition of Employment as Manual Scavengers and their Rehabilitation Act was enacted in 2013, with a broadened ambit to provide for rehabilitation of manual scavengers, in addition to abolishing manual scavenging. Section 5 of the 2013 Act states that no person, local authority or any agency shall, after the date of commencement of this Act,

“Engage or employ, either directly or indirectly, a manual scavenger, and every person so engaged or employed shall stand discharged immediately from any obligation, express or implied, to do manual scavenging.”

Further, the Act commits to providing alternative livelihoods and other assistance (such as cash payments, scholarships for children, housing and other legal and programmatic assistance) to help rehabilitate former manual scavengers and their families. The act defines any cleaning without the use of protective gear and cleaning devices as hazardous, and puts forth detailed rules for the use of protective gear, cleaning devices and obligations of employers towards sanitation workers under the Prohibition of Employment as Manual Scavengers and their Rehabilitation Rules, 2013. The rules also list the obligations of employers engaging sanitation workers for the cleaning of sewers/septic tanks with sufficient safety control equipment. The Act prohibits entry of sanitation workers into the sewerage system, except in the following scenarios:

1. Removal of manhole doors where mechanical equipment cannot be put into operation
2. Inter-linking the newly laid sewer mains with existing sewer mains, in case of sewer size of more than 300 mm in diameter
3. Removal of submersible pump sets fixed at the bottom of suction wells
4. Construction of manholes or rectification of sewer mains, when it is technically difficult to use mechanical equipment
5. Any other circumstance, when it is absolutely necessary to have manual sewage cleaning, can only be permitted by the CEO of the local authority after recording in writing the specific reasons for allowing such cleaning.

Box 1.1: Applicability of The Manual Scavenging Act of 2013 to Desludging Operations

The Manual Scavenging Act of 2013 applies to all sanitation workers including those cleaning septic tanks. However, the applicability of the Act to desludging operations is not always clear. For instance, the conditions 1-5 stated above are oriented towards a sewer system, while the reasons for entry into a septic tank are completely varied as listed below:

1. Removing blockages from inside a tank
2. Repairing the walls of a tank
3. Client's insistence on cleaning the tank thoroughly
4. The worker's intent to make more money by cleaning the tank

Further, condition number 5 of the law is open to interpretation and can be misused in many aspects

Source: IIHS Analysis, 2018

With respect to punishments, Section 8 of the Manual Scavenging Act of 2013 states:

“Whoever contravenes the provisions of Section 5 shall for the first contravention be punishable with imprisonment for a term which may extend to one year or with fine which may extend to fifty thousand rupees or with both, and for any subsequent contravention with imprisonment which may extend to two years or with fine which may extend to one lakh rupees, or with both.”

The offence under Section 8 is made cognisable and non-bailable under Section 22 of the Act, which means that any person coming across an instance of hazardous cleaning of a sewer or septic tank can give this information to the police, who are then required to file an FIR. The police can subsequently arrest the accused without warrant, and the accused will be required to approach a court for bail.

Box 1.2: Bureau of Indian Standards

The BIS has also issued a Code of Practice for safety precautions to be taken when entering a sewerage system, but the same does not apply to desludging operations in all aspects. Therefore, desludging operations require special attention, which has not been addressed completely in the legal ambit of the existing law and codes of practice.

Source: IIHS Analysis, 2018

1.1.2. Occupational Health and Safety

There are some legislations dealing with safety, health and welfare of workers in the organised sector. The Constitution of India has specific provisions for ensuring occupational health and safety (OHS) for workers in the form of three articles: Article 24 (Prohibition of Employment of Children in Factories), Article 39 which spells out the provision to be followed by the state (especially e and f, which mention that the health and strength of men and women should be considered while pursuing avocations) and Article 42 (which calls for provision of just and humane conditions for work and maternity relief). The statutes relating to OHS are broadly divided into three types: statutes for safety at workplaces (Factories Act, 1948, and Mines Act, 1952), statutes for safety of substances (Indian Explosives Act, 1884), and statutes for safety of activities (radiation protection rules under the Atomic Energy Act). Though comprehensive safety and health statutes exist for all these sectors, they are very sector specific and cannot be replicated as is for other sectors, especially the unorganised sector.

India has also sought legislative reforms in the form of a Working Group constituted in the Ministry of Labour in 1983, comprising representatives of the relevant ministries of the Government. The Group decided that a general law must be framed, but its administration must be left to the existing departments of the government concerned. It recommended the setting up of a Safety and Health Advisory Board to ensure effective administration and coordination of various functions under the new law. It is clear that it will be a time-consuming affair, requiring inter-sectoral involvement and closer coordination with implementing agencies. Therefore, it will be a challenge to include the informal desludging sector dominated by private players of a certain caste to receive a comprehensive law for OHS. A Draft Labour Code on Occupational Safety, Health and Working Conditions, 2018 has been circulated for comments by the Ministry of Labour and Employment³.

³ The Code seeks to amalgamate 13 laws relating to factories, mines, dock worker, building and other construction workers, plantation labour, contract labour, inter-state migrant workmen, working journalists and other newspaper employees, motor transport workers, sales promotion employees, beedi and cigar workers, cine workers and cinema theatre workers.

The National Policy on Fecal Sludge and Septage Management (FSSM) issued in February 2017 is the first of its kind to recognise FSSM as a separate component under sanitation. The key objective of the urban FSSM Policy is to:

“[S]et the context, priorities, and direction for, and to facilitate, nationwide implementation of FSSM services in all ULBs such that safe and sustainable sanitation becomes a reality for all in each and every household, street, town and city.”

Apart from the main acts and rules enacted for the safety of sanitation workers, various government orders have been issued as a response to petitions filed in support of sanitation workers and also to enable state-level functioning of the acts. Adhering to the Central Acts, states have passed orders starting from 2005 to operationalise abolition of manual scavenging. For instance, as per the high court order of one state, all entry of sanitation workers into sewerage system is prohibited along with the manual cleaning of septic tank and all processes need to be mechanised. Furthermore, Executive Authorities are expected to assist in accomplishing the tasks of the 1993 Act and carry out investigation and impose penalties on the defaulters of the Act.

Through the establishment of the National Scheme for Liberation & Rehabilitation of Scavengers in 1996, a total of 797,112 scavengers were identified (23.6 per cent rehabilitated, 9.3 per cent trained) in India, with one state reporting to identify 62,000 scavengers (16 per cent rehabilitated, 1 per cent trained).

The National Safai Karamcharis Finance and Development Corporation (NSKFDC) was incorporated on 24 January, 1997 under Section 25 of the Companies Act, 1956, as an apex institution for all-round socio-economic upliftment of the safai karamcharis and their dependents throughout India and to extend concessional financial assistance to them for establishment of income-generating projects. NSKFDC provides loans to the safai karamcharis and their dependents through the state channelising agencies.

2. Objective and Methods

2.1. Background

This study on stakeholders in the desludging industry aims to understand current occupational safety practices, and the resultant health hazards and safety issues of desludging workers in one Indian city. Furthermore, the study aims to identify ways to improve occupational safety through mitigation, prevention and protection.

2.2. Study Model

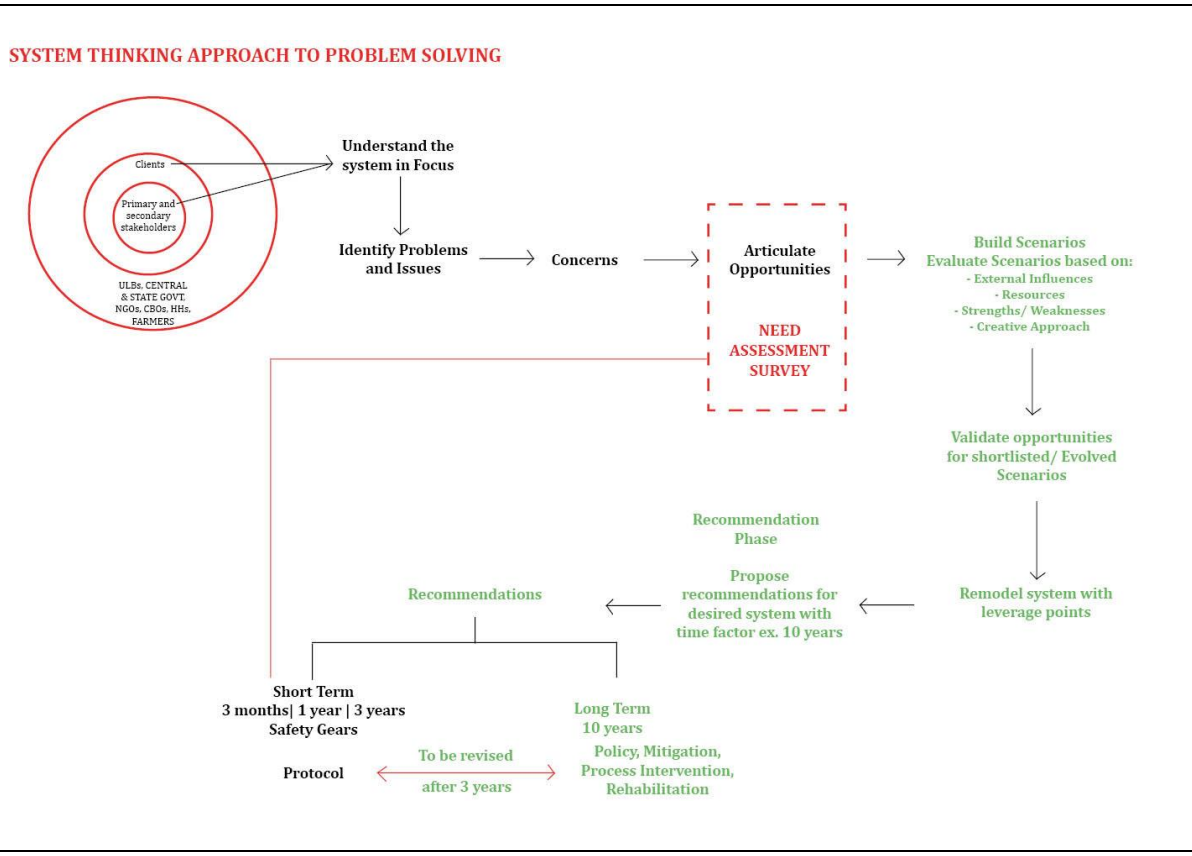
The study is structured around a systems thinking model, which focuses on how different things being studied interact with the other constituents of the system – a set of elements that interact to produce a behaviour, of which it is a part. This is in sharp contrast to traditional systems which focus on individual pieces of what is being studied. In effect, instead of isolating smaller and smaller parts of the system being studied, systems thinking works by expanding its view to take into account an increasing number of interactions. Such an approach is particularly relevant in complex problems which require many actors to see the big picture, recurring problems which have been made worse by past attempts to fix them, problems where solutions are not obvious and in issues where actions affect the environment surrounding them (Aronson).

Desludging workers operate in a complex sanitation system which involves multiple stakeholders such as the workers, households, government officers, law enforcers, decanting station operators, and farmers, among others. For the purpose of this study, desludging has been understood as a service and its relationship with service receivers. However, desludging is not just seen as a septic tank cleaning service but studied in depth to understand the role played by desludging workers in the larger and complex network of relations and equations between establishments, Urban Local Bodies (ULBs), governments and those receiving the service. The primary objective of the study is to understand in detail the issues that arise or exist while operating in this complex network of interdependencies and relationships from the point of view of stakeholders. The intention is to gain insights by delving deeper, beyond the first layer of the issue, and to gain insights hidden behind stated job profiles, roles, service operations. The study understands the need to extend the same approach to other components of the sanitation chain at a later stage before implementing any of its findings.

The service provider, referred to either as the primary (those who actually undertake the desludging activity) or secondary stakeholder, and the service receiver, referred to as the client, were studied in detail while being sensitive to every stakeholder's constraints/issues. The main focus of the study has remained on the primary stakeholders, who are vulnerable to the highest health and safety risks in the larger system.

Relying on deductive (drawing logical conclusions from data), inductive (looking for patterns and generating meanings through observation) and abductive thinking (forming a hypothesis), the study uses a human-centred, non-linear and open-ended data collection and data analysis approach. This approach allowed for continuous feedback by revisiting the earlier activity to fill gaps, update insights or events, and remain in the feedback loop in order to arrive at a clearer understanding in an iterative manner. The study team made observations in natural surroundings without being intrusive and met respondents in different contexts multiple times in natural and informal settings. The study also made an attempt to gain insights into the thought processes of the respondents and applied various means of verifying and cross-checking from multiple viewpoints. The study was agnostic in its approach and began with a clean slate and did not make assumptions based on face value.

Figure 2.1: Systems Thinking Approach to Problem Solving



Source: IIHS, 2018

2.3. Objective of the Study

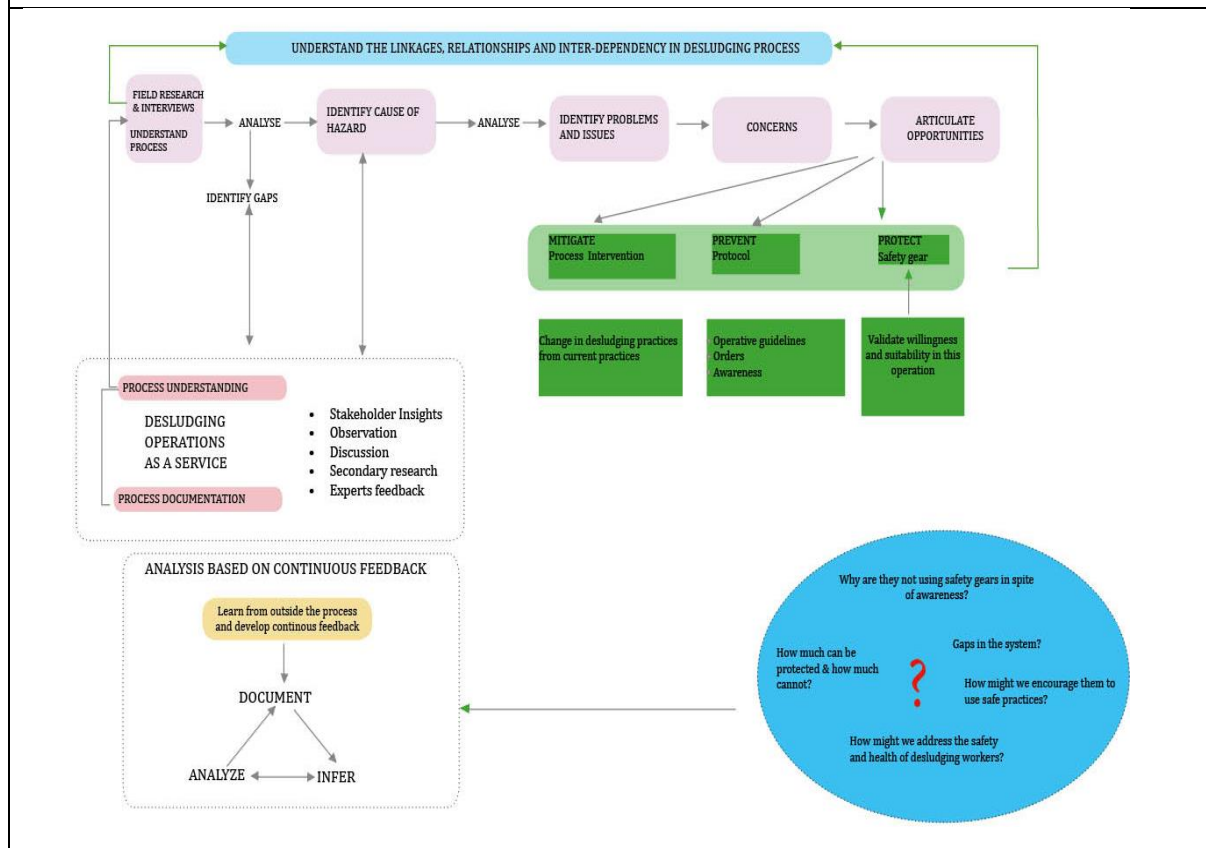
The aim of the study was to

- Undertake in-depth analysis of current desludging practices (including measures for occupational safety) with the aim of understanding resultant safety and health hazards for desludging workers
- Understand the underlying reasons (knowledge, behaviour etc.) for occupational practices and existence of hazards
- Understand the relevance and sufficiency of legally-mandated PPE and understand challenges in usage
- Develop a preliminary set of recommendations for improvement of OSS

2.4. Study Methods

The study has collected information on the field through different means of observation, secondary research, structured interviews with subject experts, and their feedback in order to validate insights gathered through unstructured interviews with primary stakeholders. Inference and analysis was a continuous loop where one informed the other to emerge with clarity within the study’s scope of work.

Figure 2.2: Study Model Used for the Study



Source: IIHS, 2018

The following methods were used as a part of the study:

- Literature Review:** Review of OHS standards, including those in the USA, UK and India, was undertaken along with a study of the existing laws in India on manual scavenging. In addition, health studies across the globe for sanitation workers and safety standards in other parallel industries have informed the study.
- Stakeholder Interviews and Discussions:** Interviews with stakeholders were undertaken to understand their approach to work, processes, concerns and hazards. Based on preliminary analysis, an in-depth questionnaire was developed for OHS.
- Qualitative Unstructured Interviews with Clients (Households and Establishments):** As a part of the study, various clients have also been interviewed. The intent was to understand their perspectives on desludging and how this may impact the future course of action.

- d. **Interview with Experts:** The study involved conducting interviews with experts in various fields like the law and OHS. These were done with the aim of gathering perspectives and also validating the study findings.
- e. **Process Documentation and Analysis:** A detailed step-by-step documentation of the desludging process was undertaken. Based on observations, each step has been analysed to understand points where sludge comes in contact with the human body and resultant hazards. Current methods used by stakeholders to avoid hazards have also been documented.
- f. **Mock Testing of Safety Gear Sample Kit:** To develop a safety gear sample kit, as a first step, detailed secondary research has been done on available safety gear in order to understand existing standards of manufacturing and usage. Based on secondary research and market availability, safety gear sample kits were purchased and mock tested by desludging workers. Their intuitive responses to the gear, along with the gear's suitability for desludging operations, were recorded.

2.5. Stakeholder Identification and Sample Selection

Primary stakeholders

The worker, driver and owner-driver are the **primary stakeholders**, as they engage in desludging activity directly. They were first identified on the basis of:

- Their willingness to interact with the team
- Their response when the study subject was introduced
- Their availability for the interview, as they had to be alert while working on the job

After this first round of basic interactions, the sample size was determined on the basis of factors such as – ‘user profile relevant to health and lifestyle’, ‘their attitude towards health and safety’, ‘technical expertise in desludging activity’, ‘years of experience in the profession’, ‘their understanding of safety gear’ and ‘their inputs to the research questions’. The workers include two ULBs desludging workers who were shortlisted for longer engagement for the purpose of study. The number of respondents has been chosen on the basis of numbers required to inform all themes under study. Using the registered list of vehicles and owners, sample size was decided upon to get a broad representative view of all stakeholders. The following number of respondents were identified by category as shown in Table 2.1:

	Registered Vehicles and Owners List Received from IIHS	Sample Size (% of total sample)
Owners-cum-Drivers	15	6 (40%)
Drivers	46 (as many numbers of vehicles)	8 (17%)
Workers	106 (+/- 20)	12 (11%)
Owners	27	4 (15%)
Total	184	31 (17%)
Source: IIHS, 2018		

Secondary Stakeholders were those that were not directly connected with the physical act of driving and desludging. They own the business and are legally accountable for the safety of desludging staff while on work. Instead of conducting basic and exploratory interviews with everyone, a sample of four

owners was selected based on their experience in the profession, areas of operation, community connection and personal history.

Experts were selected for their knowledge on safety and health and were contacted either personally or through phone or email to understand their perspectives on various aspects of the desludging process and occupational safety and health hazards. They were selected for their knowledge on technology, process, safety, health, law and administrative aspects. A total of 14 experts, both in the city being studied and at the national level were interviewed with the aim of addressing the issues identified in the study, getting their perspective on study themes, and getting their opinion in visualising a scenario that might help the study to develop creative opportunities for its assessment needs. Annexure 1 presents the names of experts interviewed for this study.

2.6. Data Collection and Analysis

The interviews with stakeholders were conducted over two months in March and April 2018, and safety gear testing was conducted in the last week of April. All interviews were recorded in the audio format and subsequently translated from the local language to English. The duration of the discussions ranges from 30–60 minutes. The study used the inductive approach for identifying patterns and generating meanings through observation. The study team had members from varied backgrounds and this helped bring diverse experiences into play. The study had developed a questionnaire and key questions around which the discussions were structured and recorded. The team depended on its observations to analyse a lot of the information that was being talked about. In addition, several informal discussions were carried out with stakeholders over tea and lunch in a non-intimidating manner to put stakeholders at ease and gain their confidence.

The study depended on video recording for capturing the process scenario and mock testing wherever clients gave their consent. The team took precautions to capture the desludging activity in an observational format and made best attempts to ensure that their presence did not interrupt the process of desludging.

Only some of expert's interviews could be audio recorded, considering the comfort of the respondents.

Analysis of information in the study was done in an iterative manner. The information collected in the field was validated by secondary sources as well as expert feedback. The questionnaires were evolved through an iterative process of going back to field with a new set of questions after validating facts from different sources. The study was sensitive to the needs, constraints, mindset, and lack of information among the respondents throughout its field research and has made sincere efforts to document, infer and analyse information in an agnostic manner.

2.7. Limitations of the Study

The study has attempted to cover everything under its scope. The limitations as faced in the field are mentioned here.

1. Some limitations have arisen primarily because they were outside the scope of study:
 - Industrial establishments were not a part of the study
 - The study did not include desludging workers' personal and home environment. However, some amount of probing would have helped in understanding health hazards.
 - The study has not probed deeper into caste identity and problems faced by the desludging workers. A detailed socio-ethnographic research may be conducted on them to understand their thought processes, business practices, social and caste identity.

- The scope of the study did not include secondary research on similar septic tank systems within or outside the country. Hence recommendations for preventive measure are based purely on the study observations.
2. Even though national-level experts were interviewed, they could not throw much light on health hazards for desludging workers, owing to absence of prior experience with the specific subject. Further, they did not participate in the field visit to make the connections between the exposure and the associated hazard.
 3. The study has not differentiated between risk and hazard as different parameters because this requires experts from risk assessment and hazard identification to study the process in detail for a longer duration to differentiate between the two. The study has discussed all under the theme *hazard*.
 4. Other forms of on-site sanitation systems such as twin pits were not studied, as they could not be identified.

3. Process Documentation and Analysis

The key method for identification of health and safety issues was to document the process of desludging in various types of settings like households, apartments, restaurants, colleges, women's hostels and public toilets. The process was documented through multiple levels of observations and has been divided into four major zones and 56 steps. This chapter discusses the details of the four major zones and the steps there, the time involved and the many concerns at various stages.

3.1. Process Description

The desludging process was categorised into four sub-activities, referred to as zones, based on physical demarcation of space (Figure 3.1). The study has observed the desludging process as being carried out by private operators as well as ULB operators. Annexure 2 presents the details of the four zones and 56 steps involved in the desludging process along with time taken at each stage. The process has been divided into four zones as follows:

Zone 1 - Reaching the site: Under this, the primary stakeholders reach their respective workplaces in the morning. They clean their vehicles and prepare for the day. After receiving a phone call (from a client or the owner), they set out to their respective site.

Zone 2 - At the site: Once they reach the site and have parked the vehicle at a location closest to the septic tank, the first step is to conduct a site assessment. First, workers assess the distance between the septic tank and the vehicle to decide on the number of hoses required to clean the septic tank. Second, based on type/condition of the septic tank, especially the covering, they determine how to open the lid and the slab. Third, they check for the presence of poisonous gases in the septic tank through the vent pipe. Then they unload the tools required to remove the slab to open the tank. Once opened, the tank is checked for the presence of cockroaches as they indicate that there is some oxygen in the tank, and therefore indicate a lower concentration of poisonous gases. If a vent pipe or cockroaches are not present, then the flame method is used to test the presence of poisonous gases. If they suspect that there are poisonous gases, they leave the slab open for 5–30 minutes, depending upon the intensity of the gases as gauged by them.

Suction hoses are then brought from the vehicle and connected to each other to connect the vehicle with the septic tank. The tank is emptied with technical expertise and finesse, with patience and meticulousness. In this, some steps can get repeated because multiple trips may be required depending upon the size of the septic tank, volume capacity of the vehicle, and sometimes the opportunity to make more money. When the septic tank is emptied, the client inspects the work and pays money for the work. If the client insists on getting the inside of the tank cleaned, then the process takes much more time. Sometimes the worker offers to clean the tank, in order to make more money for himself.

Zone 3 - Inside the septic tank: Getting inside the septic tank is declared unlawful, and even more hazardous if the worker is without proper safety gear. Often there are functional reasons for clearing blockages or repair/masonry work, but equally, there is no functional reason to enter the septic tank. Blockages are caused by foreign objects in the tank, especially sanitary napkins and other objects such as pens/glass etc., which could be hazardous. Workers enter the septic tank with the help of a ladder and clear the blockage or simply clean the tank. Typically, they apply a thick layer of coconut oil all over the body so that sludge does not touch the body. They clean themselves with water inside the tank, and bathe with fresh soap once they come out of the tank.

Zone 4 - At the decanting station: After the driver parks his vehicle at the decanting well at the decanting station, the worker connects the suction hose to empty the sludge into the well. While this is happening,

they chat with each other, or talk on mobile phones or simply relax. They might have lunch, if it is lunch time; or proceed to complete the next work order. In case there is no work order and if it is a new locality, the operators take the opportunity to spread information about their services by distributing their business cards to local households and proceed with the day by either going back to the decanting station, their respective stands or lunch or mid-day snacks.

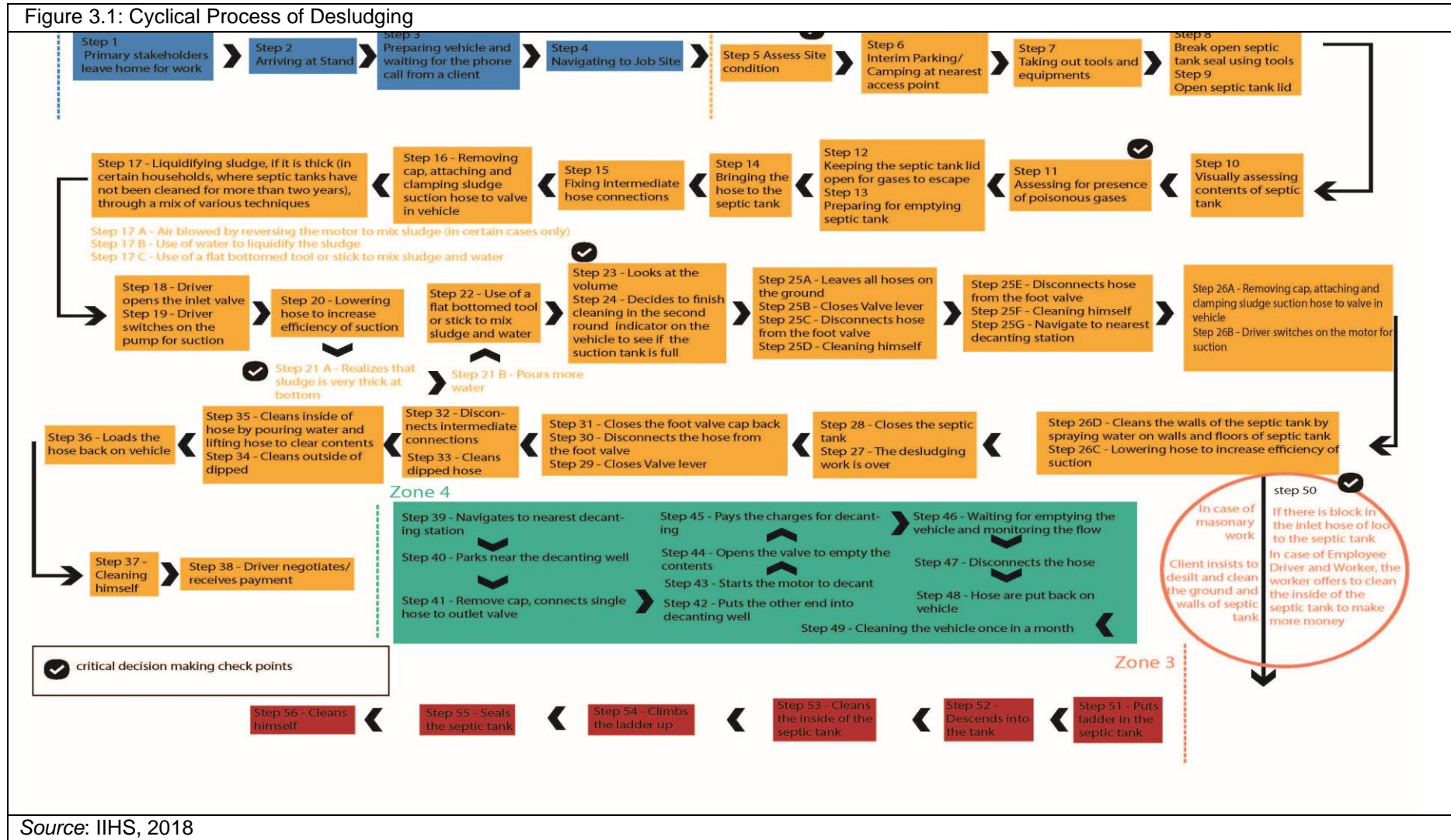
3.2. Critical and Hazardous Decision-Making Points

As can be seen in Figure 3.1, an activity that is linear might turn cyclical depending upon the critical decision check points. Some of the critical decision-making steps (Table 3.1) for private operators in the process are gauging the volume of septic tank, nature of sludge, presence of harmful gases and blockages (which make the process cumbersome). This could result in either multiple trips to decanting station or having to enter the tank to empty, both of which are major factors affecting the price to be charged. This very cyclical nature has been represented below in Figure 3.1 on the following page.

Table 3.1: Critical and Hazardous Decision Points in Cleaning a Septic Tank	
Critical Decision Points	Hazardous Decision Points
<ol style="list-style-type: none"> 1. Gauging the volume of the septic tank 2. Nature of sludge 3. Presence of harmful gases 4. Blockages 	<ol style="list-style-type: none"> 1. Assessing the site condition 2. Breaking open septic tank seals using tools 3. Visually assessing contents of septic tanks 4. Assessing the presence of poisonous gases 5. Realising that the sludge is very thick on the bottom of the septic tank 6. Checking the volume indicator on the vehicle to see if the suction tank is full 7. In any of the following events <ol style="list-style-type: none"> a. Block in the inlet hose from the toilet to the septic tank b. In case of masonry work c. Clients insisting on having the ground and walls of the septic tank cleaned
<p><i>Source: IIHS, 2018</i></p>	

Some of the hazardous decisions include assessing the site condition and how to desludge the septic tank, especially based on access to the tank. Furthermore, if the tank is sealed, breaking open the tank could be hazardous as it can expose the workers to accumulated hazardous gases. Assessing the contents of the tank and the presence of poisonous gases are also hazard-related decisions for the worker. While cleaning if they realise that the sludge is very thick at the bottom, they would need to get in to clean it, which is hazardous. Similarly, blocks in the inlet hose, requirement for masonry work and cleaning the ground and walls of the septic tank may prove hazardous.

While the above process is explained for private operators, the basic difference in the activity of private-versus ULB-owned operations was that the former may not know the site or the client, or the best way to open the lid before arriving, while the ULB operators have dedicated sites – public toilets – to go to and are aware of the site conditions beforehand. Considering that public toilets are emptied on a daily basis the lids are kept open, reducing and minimising the cumbersome task of opening the lid. For the same reason, Zone 3 is not applicable to ULB operators.



3.3. Timing

The 56 steps explained above represent one cycle of desludging activity, including entering the septic tank. On average, one full trip of desludging activity (from starting the vehicle to reaching the site to emptying sludge in the decanting station) takes about 40–70 minutes, depending upon the distance between the site and decanting station, time taken to open the septic tank, time taken for poisonous gases to escape, traffic on the road, etc. If the inside of the septic tank has to be cleaned, then this process can take an extra 30–45 minutes. Further details of the steps involved in the desludging process and time taken are presented in Annexure 2. The annexure outlines some of the time-consuming activities besides driving back and forth to the decanting station, such as navigating to the job site to park the vehicle in case of narrow lanes, opening the septic tank lid depending upon lid type, and suction of sludge using a hose pipe depending upon the thickness of the sludge.

3.4. Design Concerns with the Septic Tank

3.4.1. Location

Many aspects of the septic tanks can be a source of grave concern in the desludging process. The biggest problem is the location of the septic tank in the household. The further its distance from the main road (where the vehicle is parked), the more difficult and time-consuming the process becomes. In extreme cases, distances could go as long as 60 to 100 ft. Some, including clients and owners, have themselves complained about the lack of foresight on the part of architects while providing the location of the septic tank. The types of tanks observed are presented in Table 3.2.

Establishments	Septic tank
Hotel	One septic tank located in an organically grown space was particularly hazardous. The kitchen grime from the hotel was particularly difficult to clean.
Households (9 scenarios)	Each of the nine households studied had septic tanks in different locations, and hence the suction hose length needed to be anywhere between 30–80 ft. Some hoses were placed over a 4 – 6 ft compound wall. Specific situations such as underground and over-ground septic tanks, and volume variations therein, required a customised desludging response. Furthermore, clients insist on cleaning the inside for the sake of cleanliness and to remove blockages, which requires workers to enter the tank.
Women's hostel	In the one women's hostel, two septic tanks were identified which were located on the street. There was just one outlet for both bathroom and kitchen waste and these tanks could be easily mistaken for the street drainage system. However, no menstrual hygiene products were found here, because the client had different means of disposal.
Public toilet	Four public toilets required two suction hoses of 15 ft each that needed to be placed through the grill into a new septic tank.
Apartment	In an apartment complex studied there were two suction hoses already in the slab, which has a 2x2 feet hole. These connect the smaller hose from the vehicle to the existing one so that spillage does not occur.

Table 3.2: Types of Establishments and their Septic Tanks

Establishments	Septic tank
College public toilet	This septic tank was most difficult to clean as it was full of foreign objects – sanitary napkins, pens, pencils, etc. which got stuck at the beginning of the suction hose. Workers entered inside the septic tank to prevent those objects from blocking the suction hose and took three rounds to clean the tank completely.
<i>Source: IIHS 2018</i>	

3.4.2 Slab

The slab of the septic tank is another source of concern. Sometimes, the slab is too heavy to lift up with bare hands. Sometimes, it is too weak to take the weight of the worker and could break. This poses particular risks to the worker as hydrogen sulphide gas, when it comes in contact with moisture, creates sulphuric acid just beneath surface of the slab, which can cause the slab to collapse at any time.

3.4.3 Vent Pipe

The vent pipe of a septic tank might not be functioning because of its location or improper building, thus allowing poisonous gases to accumulate.

3.4.4 Holding Tank

The two-compartment design of a septic tank allowed for the fecal sludge to be partially treated. Its design allowed for filtering of water and separation of solid waste from water. As the sludge settled and water separated, it was possible for pathogens to disintegrate the sludge into night soil and manure. The other design of septic tank, without any compartments, does not allow for separation of solid and liquid waste and thus it simply becomes a holding tank, rather than a place for creating manure. To add to this, chemicals – in the form of toilet and bathroom cleaners, shampoos, and detergents – mix with sludge. Thus, fecal sludge, today, has become a mix of fecal and chemical waste and is therefore toxic, harmful and potentially fatal in nature. When the desludging worker comes in contact with this chemical waste, skin-related issues are more likely to happen.

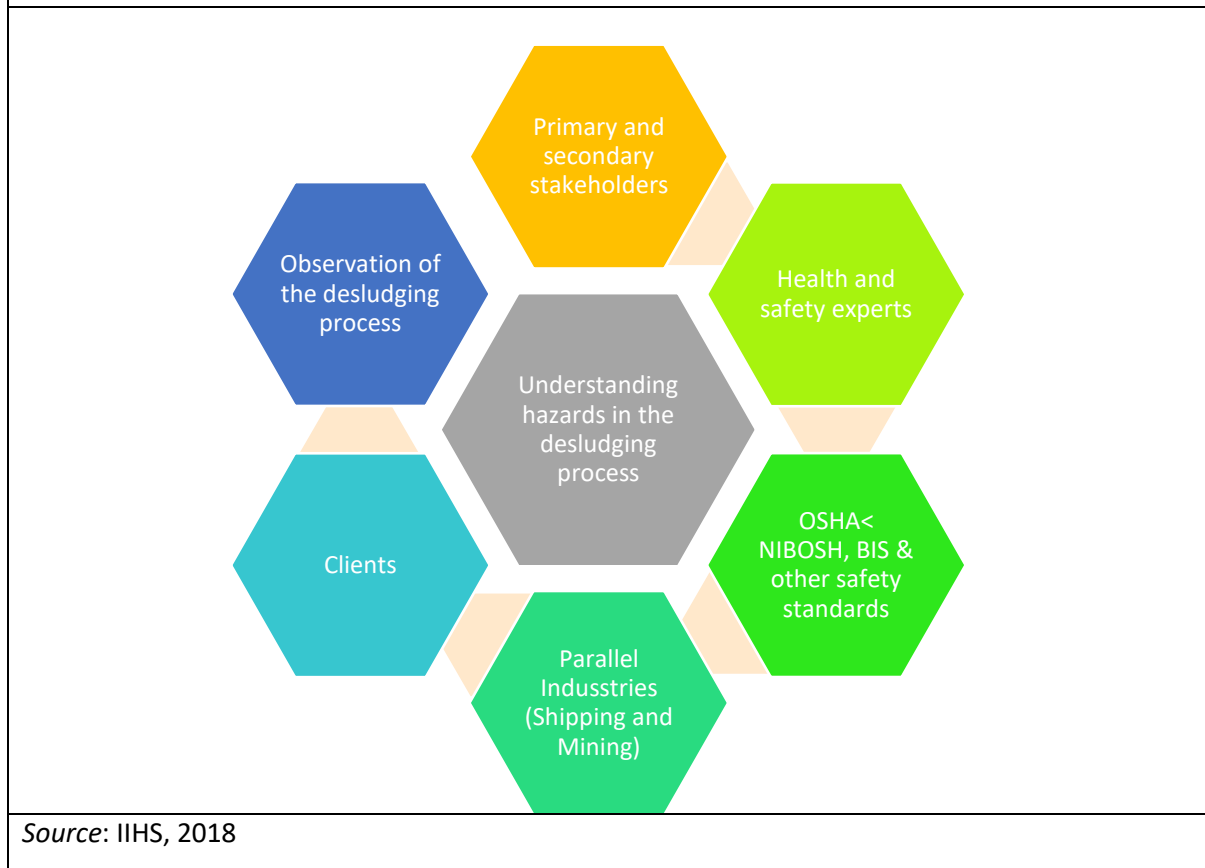
It was observed that working at night is not a norm in the city. It happens only in the case of extreme situations and medical emergencies as reported by stakeholders. One such scenario studied was in an apartment where desludging workers continued emptying the septic tank into the night due to huge volumes of accumulating grey water. The variable observed was the requirement of better lighting conditions to avoid accidents, which was taken care of by the client.

The resultant hazards and concerns are analysed in the next chapter.

4. Identification of Hazards

This chapter takes a closer look at hazards in the profession of desludging – not only from the perspective of primary stakeholders, but as understood by the observation and understanding of the process, as articulated by health and safety experts, and as addressed by safety protocols across relevant industries (Figure 4.1).

Figure 4.1: Understanding Hazards in the Desludging Process



The views of identified stakeholders have been collected through personal interviews and secondary research. All research points to the presence of poisonous gases as the most prevalent reason for health and safety concerns. Chemical and biological hazards (bleaching and cleaning agents, pathogens in the sludge and physical injury due to the process) are also problems but need to be examined further in the case of desludging.

4.1. Hazards as Identified through Secondary Research

4.1.1. Safety Protocols

Safety protocols across the world were studied, irrespective of end-usage. The shipping industry, manufacturing units, aerospace industry, construction industry, cleaning industry and others, where safety protocols are observed very stringently, were studied in greater detail to understand the kinds of safety gear that are used, means and methods engaged for its effective implementation, success ratios, etc.

The BIS has elaborate guidelines on OHS management systems, and the Ministry of Labour and Employment has a policy document on safety, health and environment.

Occupational Safety and Health Administration (OSHA) standards for safety gear pointed the study to the way forward. There are many categories of hazard (Impact, Penetration, Compression (roll-over), Chemical, Heat/Cold, Harmful Dust, Light (optical) Radiation, and Biologic). In understanding the process, the study understood that desludging process has impact (accident) related and chemical (gases) related hazards.

4.1.2. Parallel Industries

While looking at parallel industries, the study found that desludging in the shipping industry comes very close to desludging work on the ground (a certain owner-cum-driver, in one casual conversation, had mentioned that he cleaned the septic tank on a ship once, and this information was vetted with him too). The following hazards can be identified in the desludging process, based on the understanding from shipping industry:

- Atmospheric hazard, including oxygen-deficiency and flammable or toxic gases such as methane and hydrogen sulphide.
- Biological hazards including pathogens, in sludge
- Physical hazards including wounds, bruises and cuts
- Chemical hazards due to chlorine products, odour control and sewage biodegrading enzymes, sanitisers, cleaning or bleaching agents

4.1.3. Poisonous Gases

The septic tank contains a mixture of hydrogen sulphide, ammonia, carbon dioxide, nitrogen dioxide, sulphur dioxide and sometimes, even carbon monoxide. The concentration of these components differs with the time, sewage composition, temperature and pH of the contents.

Hydrogen sulphide has a characteristic smell of rotten eggs, which is easily identifiable by human olfactory organs and serving as a warning signal for sewer gas leakage (National Academies Press 2009). It is a colourless gas, heavier than air, corrosive and flammable. It can be poisonous even in small concentrations and can cause irritation of the eyes, shortness of breath (dyspnea), sore throat, and incessant cough. Prolonged exposure can cause pulmonary edema, headache and dizziness. Exposure to levels greater than 100 ppm (parts per million) can be dangerous as it causes olfactory fatigue and the smell becomes undetectable. Exposure to higher concentrations (>300 ppm) can be rapidly fatal – it results in rapid loss of consciousness (within 5 seconds) and death (within 5 minutes). Even a single breath of a concentration higher than 1000 ppm can cause immediate collapse (“knock-down”) and death. The toxicity of hydrogen sulphide is due to inhibition of oxidative phosphorylation and cytochrome oxidase resulting in reduction in cellular ATP (adenosine tri-phosphate). Inhalation leads to a multitude of respiratory complications like pneumonia and acute respiratory distress syndrome (ARDS).

Exposure to high concentrations of methane can be dangerous as it reduces the percentage of oxygen in the air and causes hypoxia and methane gas inhalation can cause asphyxia. Hydrogen sulphide is toxic, methane is explosive, and carbon monoxide is both. Inhalation of these gases in larger quantities will cause death, but even passive inhalation can cause chronic lung and breathing problems (Hariharan 2016).

4.2. Hazards as Identified through Process Observation and Stakeholders

These are the hazards as identified by the process and brought forward by stakeholders –

- Inhalation of poisonous gases while opening the septic tank:

Stakeholders have spoken about the presence of poisonous gases in the septic tank and about their means to avert casualties due to poisonous gases. These gases are hydrogen sulphide, ammonia, carbon dioxide, nitrogen dioxide, sulphur dioxide and sometimes, even carbon monoxide.

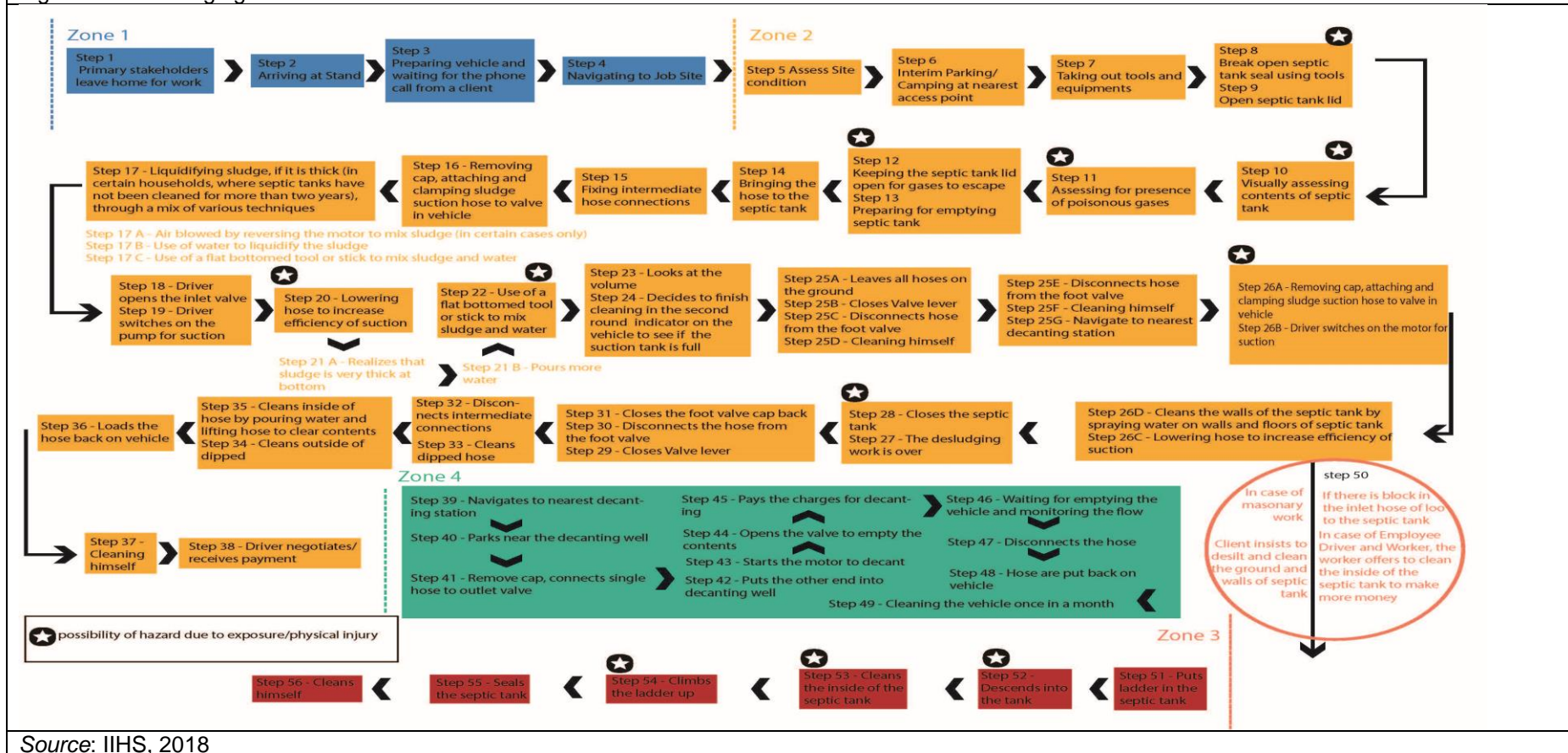
- Skin-related issues because of contact with sludge while operating the vehicle inlet valve and suction hose and inside the septic tank:

The two-compartment design of a septic tank allows for the conversion of fecal sludge into manure and filtering of water and separation of solid waste from water. Chemical waste in the current holding tank is a major cause of skin-related issues. Many primary stakeholders have complained of skin infections like itching and white spots.

- Physical injuries like wounds, cuts and bruises due to foreign objects around the septic tank while opening the septic tank and inside the septic tank:

On-site issues can lead to physical injuries to the primary stakeholders. Insects, thorny bushes, overflowing or stagnant water, or the septic tank slab can be a source of physical injuries. A range of foreign objects are thrown into the septic tank – sanitary napkins, undergarments, condoms, plastic alcohol bottles, glass pieces, pens, pencils, tissue paper, spoons, kitchen grime, etc. Many of these objects are sharp in nature. They cannot be seen in the dark-coloured sludge and cause cuts, bruises and wounds to the workers' hands and legs. Typically, workers undertake some temporary treatment (putting soil over the wound) and still continue to work. They only go to the doctor after they have finished the work. This could lead to skin and other kinds of infections.

Figure 4.2: Desludging Process with Hazard Identification



4.3. Hazards Identified by Experts

According to safety and health experts, the chief hazards in the desludging process are as follows:

- Poisonous gases
- Pathogens in sludge leading to skin-related problems
- Physical injury while on the ground or in the tank
- Chronic illness due to alcohol consumption after desludging activities

4.3.1. Health Hazards and Experts' Viewpoints

Based on their experience, health experts have cited asphyxia as the common cause of death in desludging workers. The lungs, throat and brain can be affected by prolonged exposure to poisonous gases. Prolonged exposure to and passive inhalation of poisonous gases impacts their body more than the mind, in terms of food intake capacity and increase in consumption of alcohol. Alcohol is the biggest cause of health problems, which they consume to get rid of fatigue after a hard day's work.

Proper precautions are needed when handling fecal sludge, which is however not taken. According to the skin specialists, skin diseases like eczema and psoriasis are very common – almost 50 per cent of the septic tank cleaners suffer from psoriasis, for which they seek treatment. All the experts were unanimous about stakeholders suffering from gastritis, bronchitis and other breathing-related problems due to inhaling poisonous gases, chewing and smoking tobacco. Diabetes, problems with blood pressure, backache, asthma, and arthritis could be related to their occupation, but it has to be probed further. No occurrences of jaundice, diarrhoea or typhoid have been observed in desludging workers, but theoretically, the possibility of its occurrence cannot be denied.

“As regards chronic diseases, typically lung diseases and skin diseases are what I have come across. They do suffer from bronchitis, which is caused by inhalation of septic tank gases after opening the septic tank. In extreme cases workers also suffocate to death, as reported in the newspapers. Also, about half the workers suffer from skin rashes leading to eczema, psoriasis. There are chances of getting hepatitis-B and typhoid due to contact with fecal matter, but I have never witnessed any such case in my practice.

Although workers have a certain immunity to the environment they work in, they are susceptible to a higher degree of hazards. With the introduction of machine operated suction, the chance of getting any disease has largely reduced.

They do not suffer from any other non-communicable diseases except blood pressure, which is also caused due to alcohol intake or smoking. Some of them might be anaemic and might not be taking a proportionate diet. They must be given iron supplements. Not many suffer from diabetes but some workers do suffer from blood pressure.

Most desludging workers consume alcohol to overcome the pungent smell in their work environment, because of which they suffer from gastritis. Further, they both chew and smoke tobacco, the latter aggravates their bronchitis, asthmatic bronchitis, nasal and allergy.”

– Dr Sanjeevi Perumal

“Desludging workers are prone to skin infections, as they have to come in direct contact with fecal sludge. Also, they might suffer from allergic bronchitis, wheezing problems, lung infection, and ENT problems due to inhalation of bad gases, as they do the job without any protection such as masks. I have myself offered them masks and gloves, but they simply refuse to use them or say that they are not used to it or that they cannot do the job by wearing the gloves or masks.”

– Dr Sundaraj

“Poisonous gases can be detected through combustible gas sensors, photoionization detectors, infrared point sensors, ultrasonic sensors, electrochemical gas sensors, and semiconductor sensors, as used in other industries. However, they need to be vetted for the use of desludging activity.

In a septic tank, there might not be evidence of bacterial E. coli, but there is evidence of a few strains of pathogenic E. coli passing through the sewage treatment plants. The bigger concern is the transmission of anti-microbial resistant E. coli in sewage and sludge. Detailed studies are required to understand the same. Also of major concern is viral Hepatitis that can cause severe jaundice, morbidity and mortality in few cases.

There is global evidence of occupational lung diseases and upper respiratory tract infections, allergic problems especially of the skin like contact dermatitis, neurological problems like headache, dizziness and numbness, eye problems like burning, watering and redness, gastrointestinal problems like diarrhoea and parasitic infections and musculoskeletal problems like fatigue/weakness and backache amongst sewage workers. Even studies from Mumbai and Ahmedabad support respiratory symptoms like chronic cough, chronic breathlessness, chronic bronchitis and chest tightness; aerosol of droplets might be one of the reasons. The gastro-intestinal tract and respiratory tract can get affected due to inhaling bad odours or swallowing splashes of sludge material.

Detailed and specific studies are required to propose skin, bone and muscle-related injuries as potential occupational health hazards to desludging workers. Also, the larger issues of social exclusion and caste dynamics might have some impact on their mental health. Issues such as common health problems, the impact of bad odour, impact of physical contact with fecal sludge, less hair on their hands and feet, mortality issues, have to be studied very specifically in this context.

It is often stated that the use of coconut oil offers protection to the skin and they have gained immunity due to sustained exposure to pathogens. While coconut oil is a good agent to reduce surface tension and delays/restricts absorption, as regards the immunity of desludging workers, more studies are required to prove or disprove this claim.

As a norm, workers should undergo routine tests and have preventive vaccinations. Tetanus shots must be taken as two shots initially and a booster must be taken after every 3 years. Also, HAV vaccination is required. A health check-up must include examination of blood, vital lung capacity, cardiovascular system, gastro-intestinal tract, respiratory system, dermatological issues, and mental health status.”

– Dr. Deepak Saxena

“Proper protection is needed while handling fecal sludge. Although bad odour is not harmful, prolonged exposure to bad odour impacts their body more than the mind, in terms of food intake capacity and increase in consumption of alcohol. The lungs, throat and brain can get affected by prolonged exposure to bad odour or splashes of sludge, and in extreme cases leading to death in some cases due to asphyxia.” – Dr B Alli

4.3.2. Hazards as per Safety Experts

Safety experts recommend the use of PPE such as gumboots, masks, gloves, coveralls and chemical splash goggles. Also, a first aid box is important in the vehicle and should have appropriate drugs for vomiting, among other ailments.

“The most exposed person to hazardous gas is the one who opens the manhole, and exposure is to three main type of gases – carbon monoxide, methane and hydrogen sulphide inside the tank. Hydrogen sulphide is the most hazardous and fatal – within 5 seconds, the person loses his sense of smell, in another 5 minutes, he will die, because the nerve connecting to the brain will blow away. All three are natural gases. Hydrogen sulphide is toxic, methane is explosive and carbon monoxide is both. For hydrogen sulphide gas, they must have a chemical gas mask (canister type), as a normal mask is not sufficient. When they go inside the tank, the canister type mask is required. When they are standing outside, a normal mask is enough – particulate respirators. So the particulate respirator is required for other workers, but the one who is opening the lid must wear the canister type mask.

The canister masks have an ‘End of Service Life’ indicator on the cartridge. It changes colour from red or orange to black, then it should be disposed of. The main body can be used for a lifetime, but the canister, which costs around Rs. 100-200, must be changed as soon as the indicator goes black. It is good enough for one month, depending on the user and the frequency of its use, in the context of this occupation. This canister must be always kept in an airtight cover after use, otherwise it might become useless. The user should write his name on the mask and not share it with anyone. No one else should use it. There should be no facial hair while wearing these. But because all of them have moustaches here, this will not work and 100 per cent safety cannot be ensured. This is true for any kind of respirator.

They will also feel suffocation while wearing these masks. Inside the factories, we give them work permits to be in these kinds of confined spaces for 10–15 minutes only. It is because of this issue only – to deal with suffocation. For any work that goes on beyond 15 minutes, they must wear a self-breathing apparatus. But in this case, it is not necessary.

“Cockroaches don’t need oxygen to survive. They can live with their heads cut off. In older days, they would drop down a hen. If the hen dies, they won’t go as it indicates presence of hydrogen sulphide. They use a candle; if it flashes, it means there is methane. But nowadays, we get a multi gas meter. It senses hydrogen sulphide, carbon monoxide, methane and oxygen. Oxygen levels must be minimum 19.5 for human survival.”

– Rajashekharan, Safety Audit Officer

“For protection from pathogens, we suggest chemical coveralls, chemical gloves and gumboots in nitrile and neoprene. For desludging workers nitrile is sufficient. Nitrile coveralls with full sleeves and gloves are enough. Some pathogens might be released when they handle the hose pipes. Machine-related injuries can be mitigated by applying hand brakes, stoppers, motor guards, etc.

PPE only comes as a last line of defence and will only minimise the hazard. In the case of clearing blockages in a septic tank, one must go with all the PPEs (coveralls, mask, etc) but we know that it is suffocating. The tank is suffocating, and life threatening. Yes, the PPE is also suffocating, but no one will die because of that. In the case of PPE, the biggest challenge is making workers wear it as there is resistance on account of the lack of information and discomfort. Regular training sessions are required.”

– Rajashekharan, Safety Audit Officer

“PPE is only a barrier between man and the hazard and is the last hazard control method. For workers, a canister mask, gloves, gumboots, face shield with helmet, full body coveralls and reflective jacket with high visibility are required. The reason why PPE fails is because of improper quality, poor compliance, improper size, lack of awareness about disease, improper storage and maintenance, and lack of comfort. To narrow down on the PPE for workers, the following need to be done – safety sampling, job safety analysis, job hazard analysis, hazard identification and risk assessment.”

– Angel Janet, Member of a Safety Management Institute

“Every worker must wash hands properly, cut nails, keep no facial hair. PVC body suits, nitrile gloves, face shields or hoods, goggles and gumboots, ear plugs, and light frame respirators are the recommended safety gear. The ideal gloves are unsupported PVC gloves with knurling. They must be disposed of properly, otherwise we will generate more waste, and masks must not be used again. All safety gear must be properly disinfected after a day’s work with soap and water. Also, there must be a supervisor for every desludging activity. The First Aid box must have a vomiting and nausea tablet and clean drinking water, amongst other things.”

– S. Sundaramoorthy and S Sunil Kumar, Safety Management, BHEL

Based on the synthesis of cumulative viewpoints, hazards were identified in the process and marked zone wise (Figure 4.2). Further breakup of the hazards and visualisation of the hazard is presented in Table 4.1.

Table 4.1: Breakup of Hazards Along with Visual Reference



Desludging process	Components identified in process leading to hazards	Health hazards	Safety hazards	Visual reference for hazard
Zone 2 Opening the lid (8,9)	Site conditions may not be very conducive to work	These injuries might be minor, but, if untreated, can lead to bigger septic and other health related issues depending upon injury	On-site injuries, bruises, wounds or physical injuries while: - Assessing the conditions (thorns, bushes and stones) - Opening the slab - Removing the lid with tools and equipment	
	Poisonous gases in septic tank	Prolonged and passive breathing of poisonous gases can cause breathlessness, asthma, lung and respiratory diseases. Skin infections due to contact with septage with toxic chemicals and sludge components	Accidental falling into the septic tank because of inhalation of poisonous gases. Asphyxiation (lung and cardiac arrest) or death due to asphyxiation caused by inhaling poisonous gases or falling unconscious	



Table 4.1: Breakup of Hazards Along with Visual Reference				
Desludging process	Components identified in process leading to hazards	Health hazards	Safety hazards	Visual reference for hazard
Zones 2 and 4 Removing cap, attaching and clamping, and disconnecting suction pipe to and from valve in vehicle (14, 22c, 23a, 23a, 26, 27, 28, 38, 41)	Physical contact with sludge due to spillage on different body parts	Skin-related issues due to contact with sludge due to spillage if proper personal protection is not maintained.	Bruises, wounds or physical injuries while working with pipes and inlet valve with tools and equipment, or due to foreign objects on the ground (blades, stones, thorns, shrubs, etc), on-site injuries	
Zones 2 and 4 Washing the pipe/removing the pipe (12, 13, 18, 22g, 23c, 29, 31, 32, 33, 39, 45)	Physical contact with sludge (hands and legs)	Skin related issues due to contact with sludge due to spillage if proper personal protection is not maintained.	Bruises, wounds or physical injuries while working with pipes and inlet valve with tools and equipment, or due to foreign objects on the ground (blades, stones, thorns, shrubs, etc), on-site injuries	 46_CLIENT_02_DESLUDGING PROCESS_06032018


Table 4.1: Breakup of Hazards Along with Visual Reference				
Desludging process	Components identified in process leading to hazards	Health hazards	Safety hazards	Visual reference for hazard
Zone 3 Entering the septic tank to remove blocks or to manually break the sludge for easy suction (48,49,50,51,52)	Poisonous gases in the septic tank in crevices, and physical contact with sludge	Prolonged and passive breathing of poisonous gases can cause breathlessness, asthma, lung and respiratory diseases Skin infections due to contact with septage that has toxic chemicals and sludge components	Asphyxiation (lung and cardiac arrest) or death due to asphyxiation caused by inhaling poisonous gases or falling unconscious	
Worker Habits during activity on site	Consumption of alcohol and tobacco to counter work-related stress after desludging. Alcohol is consumed only after work	They consume tobacco while at work		
Worker Habits Post desludging Activity		Health experts are also unanimous about their opinion on alcohol. They think that consumption of alcohol risks their lives over a period of time. But they also connect it with work-related stress (foul odour). Excess consumption of alcohol might lead to liver-	No cases of coming drunk to work were reported in the city amongst veterans as well as novice workers, requires further study.	

Table 4.1: Breakup of Hazards Along with Visual Reference				
Desludging process	Components identified in process leading to hazards	Health hazards	Safety hazards	Visual reference for hazard
		related diseases, though only later in life. Blood pressure problems were reported as being very common		
<i>Source: IIHS 2018</i>				

After identifying hazard components in the process, the study used *why analysis* tools to identify and understand the root cause of why a particular hazard existed in the process.

4.4. Why Analysis

Why analysis is a recognised Six Sigma tool which helps get to the root of the problem, helps determine the relationship between different root causes and can be completed without intensive data collection.⁴ It is particularly useful when problems involve human interaction and helps peel away the layers of symptoms which can lead to the root cause of a problem.

Not all problems have a single root cause. If one wishes to uncover multiple root causes, the method must be repeated asking a different sequence of questions each time. This analysis tool provides no hard and fast rules about what lines of questions to explore, or how long to continue the search for additional root causes. Thus, even when it is closely followed, the outcome still depends upon the knowledge and persistence of the people involved. The data collected by study was primarily qualitative in nature, and therefore the Why analysis tool was very helpful in understanding and getting to the root cause of each problem of the identified hazard.

The hazards, as identified in the study, have been analysed using this tool. For example, death due to inhalation of poisonous gases is a primary cause that needs immediate attention. In the analysis, it was found that the main reason poisonous gases exist in the first place is accumulation of gases, inefficient channels to let them out, and the presence of chemicals (through cleaning agents) in the tank. As can be seen in Tables 4.2, 4.3 and 4.4 on the following page, the root cause analysis has been carried out in following manner for all the causes:

Cause: Accumulation of gases –

1st why: Why do gases get accumulated in septic tanks?

This study indicates that clients clean septic tanks after long intervals for multiple reasons.

2nd why: Why do clients clean septic tanks after long intervals, what are the mechanisms for them to know when is the tank full? How do they decide on when to call desludging operators?

As observed in the field and from client discussions, the client's septic tanks gets filled in 3–4 years' time depending upon septic tank size. As a common practice, the desludging operators are only called when the tank overflows and reaches a state of no usage due to overflow, thereby creating an emergency around the service.

3rd why: On peeling the next layer of why the above is a practice, it was revealed that it is due to a tendency to try to save money, because cleaning the septic tank is the last priority owing to lack of empathy for desludging workers.

With further probing through a 4th and 5th round of why, it was understood that the root cause can be ascribed to societal mindsets and a lack of empathy for the act of desludging and desludging workers. When the root cause was understood, it has been easy to understand that solutions must be sought

⁴ <https://www.isixsigma.com/tools-templates/cause-effect/determine-root-cause-5-whys/>

through measures in mitigation – behavioural change through awareness and education campaigns, discussed in detail in the chapter on the way forward.

The second reason for the formation of gases has been attributed to the possibility of a lack of efficient channels to let out poisonous gases, rooted in lack of awareness on behalf of clients as well as masons, resulting from improper planning at conception stage of the building.

As studied through secondary sources, with aggressive use of certain chemicals like toilet cleaners, washing powders, floor cleaners, disinfectants, and materials with high concentrations of bleach or caustic soda (lye) or any other inorganic materials such as paints, solvents or water softeners, the bacterial ecosystem gets damaged – the bacteria required for the anaerobic environment in the septic tank for decomposition of sludge get killed. Imbalance in the rate of decomposition versus the rate of accumulation of sludge leads to formation of gases. This is a result of lack of awareness and calls for behavioural change.

Table 4.2: Why Analysis for Hazards while Opening Septic Tanks						
Process and Step Numbers (as in Annexure 2)	Safety Hazards and Health Hazards	Cause of the Hazard	Why - 1	Why - 2	Why - 3	Why - 4
Zone 2 Opening the septic tank (8, 9, 10, 11, 12)	<p>Safety hazard –</p> <p>Accidental falling into the septic tank because of inhalation of poisonous gases</p> <p>Death due to asphyxiation because of poisonous gases</p> <p>Unconsciousness</p> <p>Health hazard –</p>	Accumulation of gases	Cleaning septic tank after long intervals	Septic tank gets filled in 3–4 years' time. Because of this gases might have accumulated	<p>Incorrect information that the tank must be cleaned when water reaches the commode, or when the toilet stinks</p> <p>Tendency to save money, because cleaning septic tank is the last priority</p>	<p>Lack of empathy for the desludging workers</p> <p>Lack of awareness about the larger, new and changed scenario of sanitation</p>
	Inhalation of large quantities of poisonous gases (hydrogen sulphide, ammonia, methane, carbon	Inefficient channels to let out poisonous gases	The vent pipe might not be built properly or may not be working properly	<p>Lack of awareness of vent pipe specifications</p> <p>Mason may not trained properly</p>		

Process and Step Numbers (as in Annexure 2)	Safety Hazards and Health Hazards	Cause of the Hazard	Why - 1	Why - 2	Why - 3	Why - 4
	<p>monoxide) leading to asphyxiation-related deaths</p> <p>Prolonged and passive breathing of poisonous gases can cause breathlessness, asthma, lung and respiratory diseases</p> <p>Skin infections due to contact with cleaning agents</p>		<p>Crevices in the walls and lining of the septic tank could lead to accumulation of such gases, because some of them might be heavy</p>	<p>Lack of space</p> <p>Lack of awareness of septic tank specifications</p> <p>Mason not trained properly</p> <p>Use of faulty materials</p>		
			<p>Size and materials of septic tank might not be as per standards.</p>	<p>Usually, the same water tank built to store water during construction, is made into a septic tank, while connecting it with toilet and pipes</p>	<p>Importance of septic tank not emphasised and included in planning, both by owners and builders, while constructing houses</p>	
		<p>While poisonous gases are formed due to bacterial anaerobic processes, the presence of</p>	<p>Certain chemicals may damage the bacterial ecosystem of a septic tank – toilet cleaners, washing powders, floor</p>	<p>People are unaware of the consequences of the use of chemicals and the hazardous impact on</p>	<p>They also do not know of any other option but to use these chemicals for effective cleaning and that</p>	<p>Lack of empathy for the desludging workers and lack of awareness about the larger context of sanitation</p>

Process and Step Numbers (as in Annexure 2)	Safety Hazards and Health Hazards	Cause of the Hazard	Why - 1	Why - 2	Why - 3	Why - 4
		chemicals in the tank makes them more hazardous	cleaners, disinfectants, materials with high concentrations of bleach or caustic soda (lye) or any other inorganic materials such as paints or solvents, or water softeners.	the lives of desludging workers	is obviously a priority	
<i>Source: IIHS, 2018</i>						

The Why analysis similarly helped identify the root cause of septage spillage and having to touch sludge-drenched dip pipes as owing to the mindset amongst stakeholders that it's safe to touch sludge and it is not seen as a hazard at the truck manufacturer's end.

Process and Step Numbers (as in Annexure 2)	Safety Hazards and Health Hazards	Cause of the Hazard	Why - 1	Why - 2	Why - 3	Why - 4
Zone 2 Inlet valve related (16, 25 C, 26 A, 30, 31, 32, 33, 34, 35, 36, 41, 42, 44, 47, 48)		Contact with sludge due to spillage	Not seen as hazardous	No thought for user interface design at the junction of vehicle and pipe	Old pipes and valves	Operators and workers continue working with old and faulty pipes and valves to keep vehicle maintenance cost as low as possible
Zone 2 Pipe related (16, 25 C, 26 A, 30, 31, 32, 33, 34, 35, 36, 41, 42, 44, 47, 48)				No thought for user interface design for how to lift the pipe		

Source: IIHS 2018

Amongst all the hazards, entering the septic tank for reasons identified by study is the most grievous hazard although the activity is against the law. Considering its empathetic approach, the study was sensitive to stakeholders' requirements and clients' mindset, probed further by questioning the existence of the unlawful activity in spite of awareness amongst all the stakeholders.

As seen in Table 4.4, one of the main reasons for stakeholders to enter septic tank is to remove genuine cases of blockages which were difficult to detect from outside. Some of the reasons that cause blockages in pipelines to septic tanks are flushing of non-biodegradable wastes such as cigarette butts, cotton buds/swabs, menstrual hygiene products and condoms, plastics, hair, mosquito coils, pens, pencils, glass bottles and any other similar foreign objects. Depending upon the size and nature of the object, they were either found in the septic tank or clogged somewhere in the pipe network (stuck due to bends in the drainage pipe network system) reaching the septic tank.

The study found it insightful that in most cases it was objects associated with certain taboos in the Indian context that caused the blockages in septic tanks and it emerges that either the clients are unaware of the consequences of their actions or disregard of the impact of their actions. The latter is because they are not made accountable for their actions or do not respect and care for desludging operators' wellbeing.

Outside of blockages that require human intervention, another reason for entering septic tanks was stakeholders pitching to enter in order to charge more money in order to take care of their loan installments, reduce loan pressure, family's health and children's education to help them take up dignified jobs.

As observed by the study, the clients also sometimes insisted that the stakeholder enter the septic tank after emptying in order to clean it completely, owing to the lack of awareness that it is not required to remove silt and all the sludge for the better functioning of the tank. Likewise, all aspects of all hazards have been analysed and therefore all recommendations have been made based on the findings of the analysis.

Table 4.4: Why Analysis for Hazards Inside Septic Tank

Process and Step Numbers (as in Annexure 2)	Safety Hazards and Health Hazards	Cause of the Hazard	Why - 1	Why - 2	Why - 3	Why - 4
Zone 4 Inside the septic tank (50, 51, 52, 53, 54, 55, 56) (as in Annexure 2)	<ul style="list-style-type: none"> Accidental falling in septic tank Physical injury due to foreign objects in the tank (blades, glass bottles, pens, pencils, etc) Death due to asphyxiation because of poisonous gases Unconsciousness 	Entering the septic tank	To remove blocks	Caused due to non-biodegradable waste, such as cigarette butts, cotton buds/swabs, menstrual hygiene products and condoms, plastics, hair, mosquito coils, pens, pencils, glass bottles, etc.	Complicated plumbing networks and bends leading to clogging and blockages	Flushing away products that are stigmatised and considered taboo in society
			Worker tries to make more money on the pretext of removing silt	Due to pressure to make more money, to pay for EMIs, loans, financial expectations towards family	Business-minded Pressure of loans Family requirements / aspirations	Aspirations to teach children and provide good education

			<p>To make the septic tank spick and span at owners' insistence</p>	<p>Owners think that cleaning the tank from within, is a part of their jobs</p> <p>The misconception that getting in contact with sludge is not hazardous</p>	<p>Attitude towards the job – considered menial</p>	<p>Thinking rooted in old notions of caste and cleanliness</p>
<p>Source: IIHS, 2018</p>						

5. Key Findings from Stakeholder Interviews

This chapter summarises the key findings from interviews with stakeholders, who include clients of desludging operators, desludging workers, drivers of desludging workers, and owners-cum-operators. Open-ended interviews were conducted on themes such as daily routines, indigenous methods, stigma and discrimination, use of and suggestions for safety gear, and health problems, among others.

5.1. Daily Schedule

A typical day for the worker begins at 5 or 6 am with a shower, which includes the important component of oiling hands and legs with coconut oil, followed by prayer. Work starts around 7 am, with some workers having breakfast at home, while others eat at a restaurant. As they reach their parking stands or offices between 7.30 and 8.30 am, they are unaware as to how their day will shape up, who and how many people will call, whether it will be a jam-packed day or if they will go home without work. They have lunch at a restaurant, while on work, and dinner at home. Usually, their lunches consist of non-vegetarian food. Only those drivers and workers who work throughout the night (in the case of apartments), have dinners in restaurants. They work for 24 hours continuously and take a break for the next 24 hours.

On average, they undertake 1–3 trips in a day. On certain days, they might be working on back-to-back orders, while on some days they might not have any work. Work also depends on the season, with the rainy season getting them many orders and summers being the lean season.

They are not allowed to work if they are ill and their colleagues, who are also friends or relatives, will fill in for them. As their work requires focus and meticulousness, they do not consume alcohol before or while at work but do so after they have retired for the day. Some owners meet their workers every morning and converse about the last workday, instruct them on safety issues and advise against taking undue risks for extra money.

The various establishments where desludging activity is undertaken include households, bungalows, hospitals, schools, colleges, churches, apartments, hotels, hostels and community halls.

5.2. Business Policies

Desludging is still dominated by people of one caste and they take pride in their work and the fact that they keep the city clean. Owners receive calls everyday near the truck parking lot or on their mobile phones for work, and orders are executed during the day.

Most of them possess ambition and desire for economic and social mobility. Workers report taking private loans to purchase their vehicles on high interest rates (banks don't give them loans), but they work hard and pay all their loans on time. Owners have their own capital and can afford to keep vehicles and staff and are reputed names in the city. They have aspirations to improve their work processes, which include plans to venture into other technologies of cleaning and starting servicing stations for the vehicles. The owner-cum-drivers work very hard with their own vehicle (that costs about Rs 16-17 lakh) and relatives, to find at least one work order per day. They also aspire to buy another vehicle in time.

"I did a lot of business between 2000–2012. After that, many competitors have impacted on the business. In this area, most of my workers and relatives have bought their own vehicles and started their own septic tank cleaning business. I have helped them buy their vehicles." – Owner

The increasing number of operators has affected both the rates, quantum and quality of work. Rates are slashed because there is an urgency to find work amid stiff competition. But loyal clients are retained

because good service has been provided by them. Some operators cheat their clients and make money, in various ways: they can lie about the capacity of the vehicle tank, they might lie about the septic tank capacity and undertake more trips than necessary, to make extra money. Entering into a septic tank also means more money income for the workers and drivers.

“A good company will tell their clients the exact amount of sludge. If it is Rs 2000, we will tell you Rs 2000. Secondly, competitors say they will charge Rs 1000 and make 3 rounds, but a good company will charge Rs 2000 and remove all sludge in one round. Thirdly, they don’t tell you the exact capacity of the vehicle. The customer doesn’t know the exact capacity of the vehicle and hence gets cheated. Sometimes they will fake the process of desludging and do 3-4 rounds, taking all the sludge in the last round, but charging for all the rounds. When the users realise they have been cheated, they come back to us. I have lost many customers like that, but they have come back to me after realising that they have been cheated.” – Owner

The corporation sanitation workers also take orders to clean the septic tanks and later give the order to private operators. While they charge clients Rs 2,000–2,500, they give the private operator Rs 500, and keep the rest for themselves. So even as work orders have reduced, it has not been to the operator’s advantage. Furthermore, masons, plumbers and electricians have become intermediaries of the desludging industry and take commissions for referrals.

“If this business is regulated properly and all cheating is checked, only then can reputed and honest people do business. We need a common protocol for the desludging process for all, but it may not be easy to implement for all professionals. They have monthly instalments to pay, so they are not able to follow protocols. They will have to cheat their clients. They don’t and can’t follow work ethics. [He himself is a financier.] Even though we have to reduce our cleaning standards, it is very good for us that our customers are faithful.” – Owner.

Some operators also use their desludging vehicles in other cities and charge higher rates and justify this to repay their loans. The general understanding is that honest people continue to get repeat business, whereas people who cheat clients may not be able to get it.

There are mixed reactions to the future of this business. There are some who are aware of their unique ability to get inside a septic tank to clean, as they have been doing it for generations and know that they will never get out of the business. But some think that this profession will be over in the next 10 years.

“There is a shortage of cleaners. Even if we have leaves, we can’t claim them, we get called for work. Instead of 50 workers, 20 only positions are filled. 30 remain vacant. We can’t take leave. If we have festivals or marriage in our family, we have to get up at 4 am to work, and after the function is over, we resume work.” – Worker

Some of the problems in operation mentioned by the owners is the distance to the desludging plant, which increases the cost of operations as they are required to desludge in the decanting station. Additionally, owners voiced the need for a space for bathing in the decanting station for workers and a place to clean vehicles of sediments at least once a month. Additionally, sloping the ground near the well for full clearing of the vehicle has been requested at one location, but it hasn’t been incorporated in the plan. Monitoring of the entire operations by the corporation needs to improve.

“The corporation asks us to give a list of all places that we collect sludge from, how many trips we take. It is simple, if you want information, just put a security camera and see every vehicle. Instead of this, they ask us to compile information. I have spoken about this in all meetings with the corporation, ensure

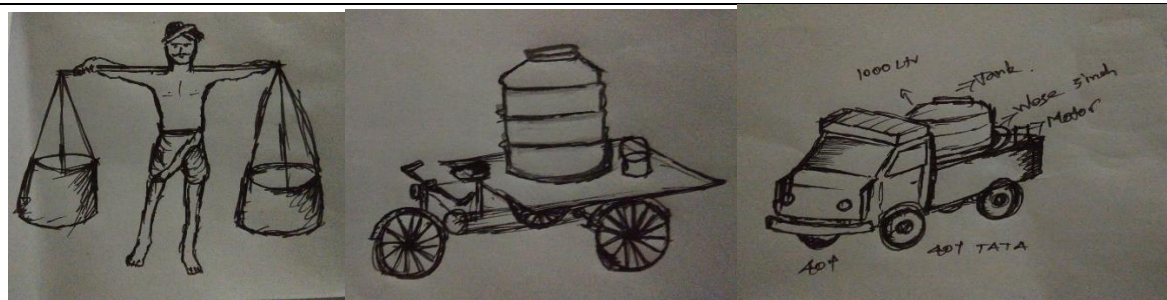
that your staff is honest and efficient, put a strict office; otherwise tender it out to private players. They will give you a perfect account. This will also generate more revenue for the corporation. The figures in the corporation don't match, so they ask us whether we are desludging in the open, which we are not. The problem is with their documentation and staff, they are corrupt.” – Owner

5.3. Evolution of Desludging Practices

Methods of desludging have evolved over time, with operators increasingly finding ways of not touching the sludge. Initially sludge was removed using oil cans and carried in buckets. Over time, it was emptied using various tools manually, filled in Sintex tanks and carried in carts. Subsequently old trucks were retrofitted with tanks and suction equipment to facilitate desludging and now purpose-built truck of various capacities are assembled in the market. The underlying principle behind this improvement in methods has been to minimise or eliminate contact with sludge.

“The reason I chose this business was my caste and started at the age of 15 with my uncle. We have been doing this work with hand and bucket. We also used coconut oil cans to remove sludge. I have carried two cans tied by a rope on my shoulders. In one village, we have carried sludge on a tricycle. Over time with some technical knowledge we put a Sintex tank and oil motor on an animal cart and carried sludge and threw it in outer areas. I made many such carts. I got a lot of business, so much that I was not able to finish my orders. I would get tired and the problem of the machine was even more tiring. Then we would only use this motor to suck the liquid, and we would pick the rest of the solid waste by bucket, for which four labourers were required.

Figure 5.1: Journey of Desludging as Drawn by an Owner



Source: IIHS, 2018

My father gave me his lorry and I took it to the STP, who are pioneers in making this desludging vehicle customised. With this, only one driver and one worker were required then. In the end the worker had to only go 2–3 ft deep and clean the sludge manually then. This machine also sucked out solid material along with liquid. So work effort was reduced, as not much cleaning remained to be done. The present machines can go to 24–25 ft in depth; Kirloskar takes 50–60 ft. They cover 300 meters of length. We can easily clean 10 meters length. I have done 500 meters also.” – Owner, desludging truck.

Some of the other reported reasons that many take up desludging as a job have been that they are keen to learn how to drive a big truck, which could lead to job opportunities as the driver for relatives in the same profession. Some of the respondents continued working owing to the entrepreneurial nature of the service where they are not bound by a 9 to 5 job and have some freedom in this regard.

The biggest driver for continuing desludging was that it was better paid compared to other jobs available to people of this community, and the lack of other job profiles for them.

5.4. Personal Safety

In terms of safety equipment, although the operators and workers understand the need and relevance for gloves, when it comes to operational aspects, they are perceived as an obstruction to completing their tasks rather than as safety gear. Furthermore, given that many have stopped desludging full loads with their bare hands, minimal exposure to clear the residues is not perceived as a major risk.

“We have always learnt to do this work with naked hands. Now we don’t have to clean septic tanks. It is simple desludging by pipe. The maximum hard work that we do is to cement the septic tank. With these gloves, it is not possible to do the cementing activity.” – Worker

“Some house owners ask us to go inside a septic tank, in which case we enter the septic tank. Sometimes, when we have to go inside, we cover our mouth with a cloth towel. The towel even if it is thick, we are comfortable with it, we wash ourselves with it, so we are comfortable. But inside the tank, it is very hot, gloves add to our sweat. With towel, it is very easy to wipe all the sweat. Even if it is hot, we are comfortable with the towel.” – Worker

There is no unanimous decision on whether two-compartment septic tank or holding tank is better for cleaning with the suction vehicle. The design of a two-compartment tank allowed for filtering of water and separation of solid waste from water. As the sludge settled and water separated, it was possible for pathogens to disintegrate the sludge into night soil and manure. To clean a septic tank meant getting this manure out of the tank for further use in agriculture, which yielded money from farmers for depositing this manure in their fields. Although this type of cleaning takes place once in 10–15 years, it was profitable for the operators. The present holding tank has a mix of liquid and solid, it is easy to clean, but has to be cleaned once every year or two. Since the time period has changed, the money charged has gone down.

The two-compartment septic tanks are no longer made. It is because the old structures allowed for water to go away while the solid waste remained. But since these two compartment tanks are very old, their slabs and coverings might not be able to take the weight of the person standing on it. This is not the case for new holding tanks, which contain more liquid material. All new constructions have this holding tank design.

5.5. Design Problems of Different Components

Typical design problems in cleaning septic tanks include wrong location or the absence of air vents or openings to insert the hose pipe. Clients have complained of architects building the septic tanks in wrong directions that can make the cleaning task a very arduous one. Sometimes, slabs are very thick and heavy and cannot be lifted at all. Sometimes, the slabs are very thin and cannot take the weight of a person.

“The septic tank is not built in the correct direction. Right now the adjacent plots are vacant, so it is easy to remove sludge. Once buildings get constructed, the truck will have to be parked at the front door and a long hose pipe will be required to carry the sludge out. The engineer did not think of this properly.” – Client

“The unanimous solution to this problem is to make a closed septic tank with holes, one for the hose pipe and the other for gas – not more than 1 ft X 1 ft in size, with a circular opening and a screw-open lid. That will eliminate the need to enter the tank.

The corporation recommends two holes, one for sludge removal by pipe, and the other for gas removal. If the tanks are cleaned every year, no problem arises. If it is not cleaned, the sludge sediments and remains there for long, making it hard to clean. It is advisable to clean every year.” – Owner

5.6. Indigenous Methods

Their technical acumen is at the core of their desludging operations and has evolved over time to include the following assessment steps by driver and worker:

- 1) The nearest distance between the vehicle and the septic tank, to assess how many pipes will be required to cover the distance
 - 2) The nature of the covering of the septic tank, what tools will be required to break the covering
 - 3) The size of the septic tank, including its depth, length, and width
- Once at site, the first thing that workers check is the air vent and its location. A well-placed air vent is the first step that indicates that a septic tank may not have poisonous gas trapped inside.
 - Cockroaches are a sure indicator that there are no poisonous gases in the tank. It is safe to clean the tank. If workers don't see cockroaches, then they check it using other methods.
 - The next method is with fire – using a matchstick, a lamp in a bucket, a candle or a burning piece of newspaper. If the fire extinguishes, it indicates a deficiency of oxygen. If the fire burns brightly, there is the presence of methane and other toxic gases in the tank.
 - The other method to check for poisonous gases is to observe the sedimentation layers on the slab. If the sediments are white in colour, it means that there are no poisonous gases. The yellow colour strongly indicates the presence of poisonous gases.
 - If workers experience watering or irritation or burning of the eyes, or trouble breathing, or if it is very hot inside, they know that there is poisonous gas (while they are inside the tank) and come out immediately.
 - If they still aren't sure about the presence of poisonous gases, they keep the tank open for about 5–30 minutes. This is how they ensure their safety.
 - They work very patiently and do not hurry through the process.
 - Getting into a septic tank is always the last resort. They are aware of the law prohibiting the act of getting inside the tank. However, there are situations when they have to get inside (especially in the case of clearing blockages). They take great care while getting inside and are accompanied by the other worker/driver above the ground. It is a well-coordinated effort, laden with communication and efficient motor skills.
 - Workers wash their hands and feet with soap and water every time they get in contact with sludge, since they are aware of health risks associated with their profession. They wash their hands before eating any meals or drinking beverages. If they get inside the septic tank, they will clean themselves with water inside the tank. After they come out, they take a new bar of soap from the client and take a complete shower again. They might not do this while cleaning commercial spaces (colleges, factories, etc).

- They swear by coconut oil. A thick layer of coconut oil prevents any sludge from getting in touch with their skin. They apply coconut oil on their feet and hands every morning and evening after shower.
- They say that they do know how to take care of their health. They drink a lot of water, eat three times a day, and eat fruits sometimes. In interviews they say they prefer vegetarian food over non-vegetarian food, but it needs to be probed further. They consume alcohol, but only after they have finished all their work and duties.

5.7. Risks in Cleaning in Septic Tanks

Blocks

A commonly reported concern by all workers is the presence of foreign objects in the sludge in the septic tank – sanitary napkins, glass bottles, plastic bottles, blades, torn fabrics, undergarments, pens, pencils, etc. According to them, sanitary napkins are the biggest problem and source of blockage, especially in women's hostels. While workers understand women's problems, they still are averse to the idea that they have to collect them with their own hands, to clear blockages. It is not that sanitary napkins are the only source of blockage, but they are fine with clearing other kinds of blockages.

Blades, razors, glass pieces (bottles) and other sharp objects in the sludge cause cuts on the body. This physical injury is usually minor but might get worse if not attended to. Typically, they apply mud on the wound, complete the work and then go to the doctor for first aid. The call from workers is for society to be considerate – not because of their status in society or their caste, but to the fact that they are cleaning away things that no one else would want to touch.

“If anyone needs to be helped, it is the people, who need help to understand that this isn't the way to behave; they have to learn that the septic tank is only meant for fecal sludge and not for foreign objects. We have cut our hands so many times while cleaning the pipes or the tanks. We face injuries because of your misgivings. Yet, we clean everything that you make a mess of.” – Worker

Entering Septic Tanks

Blockages and repair work are genuine concerns and the workers do get paid a lot for this. The septic tank contents are liquefied with water and then the pipe sucks out the waste. *“We put water till 4–5 ft and suck the sludge out with the pipe, but still the entire tank is not clean. We don't use any tools to shuffle the waste; we do it with our hands and feet, no PPE at all. We don't feel dirty, the clients give us clean water, we take bath. Besides, we are getting inside the tank also – the water used for cleaning the tank is poured on us also. So we are clean inside also, and we come out and take a shower after coming out.” – Worker*

None of the workers want to enter septic tanks but say that clients insist on cleaning it from the inside, threatening not to pay, although clients insist otherwise.

“The customers ask us to clean the entire tank as these days attitude has changed. We do go inside, clean the walls with water and then suck the sludge out” – Worker.

There are also limitations of vehicle capacity, which is marked as a red line on the indicator in the truck. If it crosses the red line, the motor will stop automatically and the suction will stop. However, the septic tank may not be fully desludged. Ground realities are very mixed and the truth lies somewhere in between.

“Owners are not bothered what the workers are doing at the site, workers take advantage of that and tell customers that we will go inside for more money. Even my workers do that. But my customers are loyal, they call me and ask if they should let the workers clean. I say that it is not legal, so don't allow them now and in future also. If you feel like, you could give them Rs 100 per head, otherwise don't. Even after that, workers bargain and ask for Rs 200. Some owners call me again, I ask them to give the phone to the workers, and they obviously don't take my call. They take whatever is given to them. When the workers return to the office, I scold and advise them to take whatever the customers give to you happily. Don't compel them (I have also lost some clients because of the workers' demands and I lose business). That is why my workers don't enter the septic tank. I have already told my clients that it is illegal to enter the septic tank. If you still wish to, it will be your own problem. Also there is no need to clean inside, since it is all covered.” – Owner

“We don't enter the septic tank, not even for a little money. Before we used to do it, after the law was passed, we don't do it anymore. The people with one vehicle will never do this work, but big company workers do it. After getting the license, we don't do it.” – Owner-cum-worker

Of course, poisonous gases are the biggest risks and can lead to death. However, so far no such instances have occurred in the city. Workers are very careful not to consume alcohol while opening septic tanks. In the tank, the moment their eyes burn or water, or their breathing becomes difficult, they stop the work and come out of the tank. They do not risk their lives at that time.

“The old septic tank is better. Since the sludge is stored in a different place than water, it is easy to clean. Besides we check for gas with a lamp or matchstick. This particular tank does not need that checking, because it has a vent outlet. We borrow the matchstick or lamp from the house owner when it is required. If we know there is gas inside, we open all slabs, wait for 10–15 minutes, and then begin the work.” – Worker

In the city, owners and workers report being very particular about our work-ethics and therefore injury / loss of lives has been prevented /minimised as the following comments reveal.

“One reason for deaths in other areas is that new workers don't know about gas sealed in the septic tank. Even industrial workers, who work with chemicals every day, don't know the danger of gas inside the fully covered septic tank. I have seen such fully covered septic tanks. We light a matchstick to check the gas. If the flame is blue in colour, we get cautious. We ask the client to keep the tank open for two days. Then we go and clean. These industrial workers don't know how to do it.” – Worker

Every time workers exit septic tank, they have a shower. They clean their hands and feet after every activity, and before consuming food or beverages in the daytime. They are very particular and maintain good hygiene.

5.8. Need for Personal Protective Equipment

Stakeholders themselves report the need for gloves and masks and say that the current products in the market do not cater to their requirements. They cite many reasons not to wear safety gear including poor grip, issues with sweat, work slowing down, additional maintenance required, diseases, laziness, and no precedents. They do take pride in the fact that they, as a community, are the only ones who can do this job without safety gear and that is seen as their advantage to remain in this business.

“Available gloves are not suitable for the hard work we do. I have purchased all safety gear with my own money after attending the meeting at the corporation. But my workers don't wear it. They tell me that the speed of the work slows down. Yes, in foreign countries, this is just a profession, so they will

wear the PPE, but for us, we have been doing it for ages, it is not a profession. At the parking station, they will obviously not wear the PPE, the moment they get a call, they run, do the desludging work, and finish their work in 30–40 minutes. They will have to wash their safety gear also, along with washing their hands and feet. So why use it? Their work time is not continuous, unlike in other industries. Some other upper-class people wear this, because their mindset is like that. We don't belong to that mind-set. Actually, a better PPE will be beneficial, but it has to be accompanied with stringent monitoring. Once or twice the owner will pay, once or twice the workers will pay, they will automatically begin to wear the PPE. But a medical camp is surely required.” – Owner

Following are the issues they have faced while using existing safety gear:

Design

- Existing plastic gloves do not help with grip while holding the pipe
- Cotton gloves are not useful once they get wet
- Plastic gloves cause boils, blisters and wounds on hands, after 4–5 days of continuous use
- Hands sweat a lot
- Gloves are not useful for heavy lifting work
- Work slows down if we wear PPE
- If sludge enters gloves and boots, then it is a major problem
- If gloves or footwear gets wet, that will give rise to skin problems
- Present masks (like surgical masks) are not acceptable because the operators work in the open and sweaty environment constantly. Once the mask gets wet because of sweat, then there is more chance of contracting disease
- Currently available masks (like surgical masks) prevent ventilation and don't allow sweat to evaporate

Mindset

- We bathe immediately after every desludging activity, so there's no need for safety gear
- Friends don't wear it and they will laugh at us
- Clients think that we will charge more money if we wear safety gear
- We have strong immune systems and are very deft at our work, nothing can happen to us
- It has become a very safe occupation now, we don't need safety gear for sucking out the sludge
- We will have to worry about safety gear getting damaged, and might not be able to focus on work
- We don't have time
- Don't know where to buy safety gear from
- Cleaning safety gear is an additional task
- Laziness is also a reason

Lack of Awareness

- Some are not aware of the rule that it is mandatory to wear safety gear while desludging
- When we think about safety gear, we imagine ourselves inside the septic tank and our understanding of safety gear is limited to this scenario
- Some don't know how to wear safety gear

Not seen as value for money

- Safety gear is seen as extra expenditure

-The protection is not considered worth the expense of having new gloves and mask everyday

“Plastic gloves cause boils/blisters/wounds on the hands besides being sweaty and so I don’t use them. When I have to use force to remove solid particles by shaking the pipe, gloves are not helpful as they don’t give the required grip. I have used them earlier. For 4-5 days, it was okay, but after that I got blisters. Also, gloves are not useful for heavy lifting work. Yes, the corporation provides gloves, they are there in the vehicle, I wear them when supervisors come. We can wear them for one day, not more than that. They give us one pair; one-time cleaning is no problem. But we wash hands after every desludging activity, this wetness gives me infection.” – Worker

Similar problems exist with footwear, as they get wet and get damaged in 2-3 days’ time, besides providing poor grip while climbing the truck. Some footwear such as those made by Paragon are sturdy, but the ones given by the corporation are not, and are given out only once a year. Some workers prefer chappals to other footwear as they help keep the feet dry. However, even chappals last just two months, developing holes subsequently.

Workers express the need to wear one new mask every day. Repeatedly wearing the same mask with accumulated odour and sweat is unsustainable.

“Safety gear is required, but a mask is not required; we are used to the smell. But we need gloves and shoes, as we have to touch the sludge. So intervention is required there.” – Owner-cum-driver

“I tell them to wear full clothes, but then we will have to wash the clothes also. So they go bare into the tank. Anyway, most of the time, they are bare-chested only. They put coconut oil on themselves before entering the tank. This prevents the sludge from contacting the body. Earlier there were many septic tanks, nowadays there are not many, this is a one-of-a-kind case. New septic tanks are cleaned frequently. Because it is mixed with water, it can be sucked out easily. So we don’t have to go inside, therefore we don’t really need safety gear for the body. Only gloves and shoes are required.” – Owner-cum-driver.

“I would like to wear gloves, because I have had skin allergy (itching). I don’t itch in the daytime, but in the night, I get a lot of itching. When cleaning the septic tank, when the dirty water comes on to me, it itches. I need gloves upto my forearms. I take a bath first and only then I go home.” – Worker.

“I work for 24 hours. I don’t need anything for my feet. In the rainy season I need a raincoat. Boots are uncomfortable for me, because of the lack of grip. I don’t need a mask also. We take care of our eyes. We need gloves only. For my allergy, I take injections. I used to go to a doctor in a general hospital weekly for an injection.” – Worker

“PPE is a borrowed concept; it is not applicable to their caste. Technological intervention can happen only when other caste people engage in this profession. This caste has been doing it for ages, they are immune to sludge, we are immune to them doing this work, and so any real intervention has not happened.” – Client

“We don’t like this vehicle coming in the hotel. We don’t like the foul smell. It stays on for more than 2–3 hours. The customers also feel uneasy because the smell lingers on for quite some time. Some people will adjust, some will never come to this place, some will advise us to take some steps.” – Hotel owner/client

5.9. Suggestions for Better Safety Gear

Safety awareness did not exist seven years ago, but when non-governmental organisations created awareness campaigns, stakeholders have taken to the idea of safety gear. Furthermore, when the corporation organised an exhibition for safety gear, safety gear was purchased, based on their understanding. All workers have used safety gear, but have not found it helpful in their work.

Workers have specified their requirements for the ideal gloves and mask for themselves – gloves which are about arm length, waterproof, and offer a good fit to avoid spillage and are knurling-led. Masks must protect them from poisonous gases and be lightweight. Also, workers acknowledge that they need awareness and training and monitoring. The owners are willing to cooperate with the corporation and pay fines (if caught) in order to ensure that safety gear is worn.

All are unanimous in their response that they need gloves (to prevent contact with sludge) and masks (to prevent from poisonous gases) and shared the following design/operational suggestions

Design

- Four sets of gloves for each day (for each activity)
- The lifetime of an item of PPE must be only 2 months, otherwise it leads to more infections than currently
- All safety gear must work for both inside and outside the septic tank
- Materials of the glove must be able to - fit well without any gaps, not produce too much sweat, and must be till above the elbow. Further, insides of the glove should be smooth and the outsides should be rough to have a good grip.
- Hand surface can be made with nitrile material, and the rest till the elbow can be of rubber
- All safety gear must be water- and spill-proof
- The issue of sweating can be addressed by removing the gloves after the main activity is over
- The mask and safety goggles can be combined, as it is easier to wear one than two items

Monitoring

- The law and the corporation must be strict about wearing safety gear and implementing it through fines imposed on owners
- Officers must conduct surprise checks of private operators
- Governments must give free safety gear

Cost effectiveness

- Quality is preferred for sure. They must be long lasting and durable
- Spending money is not an issue, but it must be worth the cost.
- Agree to wear if provided with free safety gear

5.10. Health Concerns

Workers generally report being healthy and suffering from no diseases, except skin infections (when they enter the septic tank), bruises, wounds (while lifting the slab or any such physical activity), and cuts and wounds (while clearing blockages inside the septic tank). In case of bruises or wounds or cuts while working, they apply mud at the time of working, and then go to the doctor after completing their work.

Typically, workers shower twice a day – in the morning and evening and also after entering the septic tank. They have said that they have high blood pressure, but they have never had headache, dizziness, eye problems, or diseases like jaundice, typhoid, diarrhoea.

“Sewage is mixed in our blood, since ages. We live in dirt, our pigs live in dirt, our caste, has been doing this for ages. They can get into the tank, clean the sludge, come out and wash themselves with soap and water, they are clean. Common people like you won’t go to these places; even if you go, you will not touch it; even if you touch it, you will wash yourselves with all kinds of soaps and sanitisers, still you won’t be able to eat food, you will be stuck there in your mind. For us, it is enough to wash with soap and water.” – Owner

No deaths due to desludging activity have been reported by the workers interviewed. There are episodes where they get hurt because some slab or rubble falls on them, but first aid is offered to them.

“No one in the staff suffers from any disease or injury. Also, in evening, alcohol reduces all pains of the body. Anyway, we bathe inside the septic tank and again when we come out. Remember that we are immune, we are born and bought up in such places only.” – Owner.

They take showers twice – in the morning and evening. If they enter inside the septic tank, they shower after cleaning as well. They wash their hands before consuming food and beverages. Importantly, it is widely believed that applying coconut oil before entering the tank helps direct prevent contact with sludge and protects them.

“A layer of oil on the whole body before entering the tank doesn’t let any sludge touch me. We have a bath after finishing work. We apply coconut oil on the full body, before getting in the tank. Nothing happens to us.” – Worker

Upfront payment for treatment in government hospitals deters access to care. There are norms of the state which provide treatment for those earning less than Rs 75,000 per annum. However, since their income is higher, they have to pay.

“The corporation should conduct medical camps every month and give antibiotics to the workers. The workers don’t want to go to the government hospital; the corporation must conduct medical check-up camps.” – Owner

“Private doctors know about us. Whenever we go to private hospitals for treatment, they immediately give us treatment; because we desludge their tanks etc. These doctors give priority to us for treatments and medicine and ask us to pay later. We make their hospitals clean, they also help us by treating us on a priority basis. Corporation hospitals don’t give us treatment properly. Like railway hospitals treat their railway staff properly, corporation hospitals should also treat the sanitation workers properly. We need some rest and compulsory leave to avoid continuous exposure.” – Driver

“If I come to know that I have any disease, I will get scared and will not be able to work. We want to keep working. May be only 5 per cent will come for a check-up. I am fit and fine, why should I go for a check-up?” – Owner-cum-driver

“Any risks/accidents are not because of the nature of this work, it could be because of alcohol or smoking or hereditary, but not because of this profession. The corporation has strictly asked for insurance of the workers which we have bought. The policy cover is for Rs 10 lakh in the case of accidental death at work to the family of the worker. The policy renews every April.” – Owner

The vehicle owners referred are primarily responsible for the safety of the primary and secondary stakeholders while in the field.

The owners shared their limitations of having purchased safety gear which was not used by the workers. They were concerned that workers would leave if they were to adopt a strict policy for wearing safety gear. The owners expressed concern for insurance of vehicle and workers and are aware of the being legally responsible for the worker's life. They were receptive and open minded about the use of safety gear and were welcoming of awareness efforts about the implementation of safety gear with a need for stringent monitoring regulations on ground.

5.11. Stigma

Stakeholders don't care about what society thinks about their work but are sometimes concerned about what their relatives might think. Generally, as long as work is available and money is earned, they are respected. Some do take pride in the fact that they keep the cities clean, but there are instances of discrimination. For instance, workers and police officers were wearing orange jackets, but the police force eventually got their colour changed to green. Although this episode was reported, it was not acknowledged by the officers. Similarly, if the workers have their jackets on, they do not get tea immediately at a tea stall. If they ask for water, they get it in a plastic container and not steel glasses. Workers overcome this stigma by bringing water and food from home.

"I was perplexed when I got this job and wondered whether I should take this up. A pujari told me that it is your bad karma from your previous birth. Accept this job." – Driver

"We can't earn a living if we think about stigma. It all depends upon how we behave. Some people treat us well and some don't. Depends on the clients. Once we work well, then we make an impression, then it doesn't change." – Owner cum driver

"We must respect everybody. There should be no discrimination. We don't discriminate against them. We give them full freedom to work their way. We give them water for drinking. We give them space in the outside bathroom to take a shower. We let them use our pipes. We have been living in the Gulf, we don't and can't believe in this kind of discrimination." – Client

Some have had the courage to speak up against it, and their clients have changed their behaviour. There is a growing understanding and confidence that they are integral to society.

5.12. Stakeholders' Work and Life Priorities

To gain further insights into specific aspects of their lives, a participatory approach was employed using resource cards. While the study had gathered insights through unstructured discussions, the resource card method helped chart out a clear pattern and understand what was significant. Two themes were specifically selected to get a better understanding of their approach to work and safety, while other themes were selected based on the study's understanding of their socio-economic statuses, aspirations, dreams, and the problems they face. A total of 15 people participated in this exercise – eight people belonged to the age group 16–35, five members were between 35–45, and two were above 55 years. There were three owner-cum-drivers, and the rest were all workers.

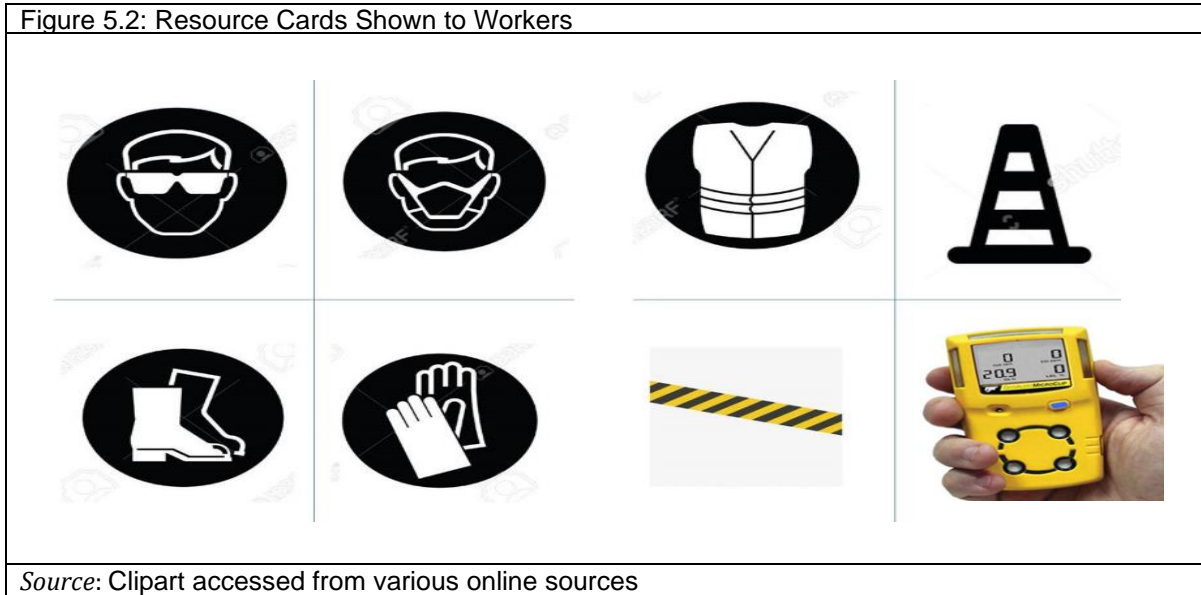
Five themes which were identified for the exercise included: - Choosing safety gear based on priority; Why do I not wear safety gear?; What do you give importance to at work?; What are your family concerns? And What do you save money for?

Choosing safety gear based on priority

Participants were given cards with the images of various safety gear asked to rank them based on priority (Figure 5.2). Gas monitors were also included in the resource cards, though it is not included in the visual below.

On analysing the ratings received by each safety gear put together, the following pattern emerged in the order of preference:

Figure 5.2: Resource Cards Shown to Workers



Source: Clipart accessed from various online sources

1. Gloves
2. Respirator mask
3. Gas monitor and gumboots
4. Goggles
5. Helmet
6. Reflective jacket
7. Safety cone and tape

Although they have identified key safety gear and ordering it by preference, the narratives outlined earlier indicate constraints and resistance to migrate to regular use of safety gear.

Respondents were asked to rank the reasons for not wearing safety gear inspite of awareness. Top three reasons listed include 'Sweating', cost ('Will Wear if Given for Free') and 'Lack of Comfort', followed by 'Time Consuming' and others listed below in the order that emerged from card rating by all respondents.

Sweating

Will Wear if Given for Free

Uncomfortable

Time Consuming

Size Issue

Hampers Work Speed

Foul Smell in Safety Gear

Additional Expenses

Poor Grip

Laziness

Not Value for Money

Maintainance Headache

Don't Know Where to Buy

Not Used to

Each constraint to use of safety gear was classified thematically as problems of functional features, economic reasons, excuses and issues of mindsets and is presented in Table 5.1. There are genuine issues of design – poor fit, inappropriateness, short shelf life, which are genuine constraints and have economic implications. For instance, workers believe that having pursued this as a profession for generations has given them biological immunity from any infections caused by sludge. They seem to have the ability to judge the extent to which sludge is dirty and wearing safety gear is seen more as a bother than a protection.

Table 5.1: Analysis of Reasons for Not Using Safety Gear

Functional features	Economical (also others)	Excuses	Mindset
Need safety gear that can work both inside and outside	Will wear if given for free	Not used to	We bathe immediately after we finish our work
Slippers are better	No value for money	Work time is too short, therefore don't need	I work in an apartment, here water is not dirty
Time Consuming	Additional expense	Laziness	Wearing safety gear will not allow us to make money
Sweating	Don't know where to buy from	Safety gear is ineffective as it doesn't help when we go inside the tank	We only need it for work inside the septic tank, but the current safety gear doesn't work

Table 5.1: Analysis of Reasons for Not Using Safety Gear

Functional features	Economical (also others)	Excuses	Mindset
Maintenance headache		Need to take care of safety gear instead	Don't feel the need to wear
Need to keep changing		Peer pressure (among youngsters), therefore, not a part of popular culture	No knowledge and training
Poor Grip		House owners are skeptical we will charge more money	There is no rule that says you must work with safety gear
Foul Smell		Fear of losing business	Nothing can affect us
<i>Source: IIHS, 2018</i>			

The respondents were asked to list which aspects they gave importance to at work. Their primary concern was their own 'health' followed by 'safety' and 'work satisfaction'. Towards their health, workers report using coconut oil for protecting themselves from contact with sludge, having a shower after coming out and cleaning themselves with soap. Also, not entering the tank while drunk or sick and checking for gas before entering the septic tank are some safety precautions they take. This is followed by 'client satisfaction', 'vehicle', 'co-workers safety', 'self-hygiene', 'safety gear', 'technology' and 'owner'. 'Money', 'time' and 'friendship' are their last considerations.

In terms of family priorities/concerns, the top five priorities mentioned are overwhelmingly towards health – health of 'parents', 'children', 'wife', 'own health' and also children's education. Essentially, they are family-oriented people, and are working very hard to create a better life for themselves and their children. Other family considerations include – 'children's future', 'respect', 'recognition in society' and relatives, followed by pet animals.

Respondents were also asked what they save money for. Personal and family financial security is of prime concern with them. Top three reasons include – 'need to buy own house', 'children's education' or towards purchase of 'land'. This was followed by aspiration to buy 'own vehicle for work' or 'household amenities'. Other aspirations include – marriage, purchase of two-wheeler, old age, building other business, buying gold, festivals, community feasts and pilgrimages. Essentially, they are all hard working and aspire to climb the socio-economic ladder. They are concerned about their own future and the future of their children but are always resilient and ready to fight the battle of life with courage and confidence.

The clear patterns on all the above five themes including use and non-use of safety gear, insights into their mindset on safety gear, and personal aspirations put together by the study are insightful resources to chart out a future course of action on safety gear awareness and training campaigns.

6. Safety Gear

In order to understand the role of safety gear in protecting against health and safety risks and hazards, an intuitive and function-based user-centric study of safety gear was taken up. Desludging is not an organised sector and the law only outlines common guidelines and mentions what safety gear is to be used without mention of specifications required to address the same. Designing safety gear for any industry is a resource intensive and time-consuming task. In this backdrop, the idea behind testing safety gear is to chart out a future course of action by leveraging safety gear that already exists in the market for other or parallel industries, and assessing what they can offer in terms of protecting stakeholders.

6.1. Identification of Safety Gear

Interactions with stakeholders indicated that while they understand and appreciate the relevance of safety gear in their work, the absence of products that suit their specific requirement was clearly articulated. Towards addressing this issue, safety standards followed internationally, safety standards prescribed by law and also stakeholder's preferences/specifications were identified. Based on this preliminary research, safety gear was purchased and field tested by workers. This chapter details all the findings of the above exercise and documents the results of the field test.

6.1.1. Safety Gear as per International Standards

To understand the requirements that each safety gear must possess in order to provide protection from hazard, OSHA⁵ and National Examination Board in Occupational Safety and Health (NEBOSH⁶) standards were studied. Separate requirements have been mentioned for each kind of safety gear, which is replicated in Table 6.1 for the safety gear that the study has included in the safety kit:

Gloves	Requirement based on the type of chemicals handled Nature of contact (total immersion, splash, etc.) Duration of contact with hazard Area requiring protection (hand only, forearm, arm) Grip requirements (dry, wet, oily) Size and comfort
Air Purifier Mask	Must be tight-fitting With cartridges or canisters (for protection against gases and vapours) Must be fit tested Can be cleaned, decontaminated, and reused.

⁵ CATALOGUED ARCHIVES FOR IIHS_REFERENCE DOCUMENTS_04_HEALTH AND SAFETY STANDARDS DOCUMENTS_03_OSHA Standards for safety gear 2004

⁶ <https://www.bssukhse.com/>

Particulate Mask	<p>Ability to filter out airborne particles and bad odour</p> <p>Cover nose and mouth</p> <p>Must be tight-fitting</p> <p>Must protect against non-particulate hazards such as gases or vapours</p>
Safety Goggles	<p>Ability to protect against specific workplace hazards of sludge spillage</p> <p>Should fit properly and be reasonably comfortable to wear</p> <p>Should provide unrestricted vision and movement</p> <p>Should be durable and cleanable</p> <p>Should allow unrestricted functioning of any other required safety gear</p>
Gumboots	<p>Must be fit tested</p> <p>Must be water- and spill-proof</p> <p>Excellent slip performance on wet contaminated surfaces</p> <p>Chemical resistance to concentrates of fats, certain acids, caustics, and other chemicals</p>
<i>Source: OSHA and NEBOSH</i>	

While the above table indicates specifications for each safety gear; safety protocol is required to be followed while wearing, removing and cleaning safety gear. Since desludging operations belong to the unorganised sector, primary and secondary stakeholders are unaware of safety gear specifications and protocols.

6.2. Provision for Safety Gear by Law and Verified by Safety Experts

The Government of India provides a list of 40 kinds of safety gear and 14 cleaning devices as a part of its Prohibition of Manual Scavenging and their Rehabilitation Rules.⁷ This document was studied along with a safety audit consultant in order to identify the relevant safety gear for desludging from the vast list provided by the law. The safety audit consultant, in understanding the process, has created a list of required safety gear. Some safety gear which were not under the study purview were also identified by the consultant and studied, the results for which are also reported for the sake of completeness (Table 6.2).

Name	Requirement/Reason by Safety Audit Expert
Barrier caution tape	White and red tape can be placed around the septic tank during desludging and when the tank is kept open.

⁷ CATALOGUED ARCHIVES FOR IIHS_REFERENCE DOCUMENTS_01_LEGAL DOCUMENTS_06_Prohibition of employment as Manual Scavengers and their rehabilitation rules, Ministry of social justice, December 2013

Table 6.2: Safety Gear as per the Prohibition of Manual Scavenging and their Rehabilitation Rules	
Name	Requirement/Reason by Safety Audit Expert
Barrier cone	Barrier cone with plastic chain (white and red) can be used. Cone is better than tape as the tape cannot be reused more than twice or thrice. But cone needs storage space in the driver's cabin of the vehicle. Therefore, cone is recommended instead of tape.
First aid box	Standard first aid box contents can be kept, but drugs/medicines should not be kept, as they may induce drowsiness. Medicines, if any, must be recommended by the medical expert, after analysing the desludging operations
Hand gloves	Reusable, washable, elbow-length nitrile gloves with grip on palm should be used
Reflective jacket	Net type red-coloured Hi Viz wear to be used
Safety goggles	Chemical splash goggles with side protection to be provided. Goggles with rear band can be provided rather than with goggles with temple, as the latter may fall down into the pit/tank
Safety gumboots	Gumboots as per IS 15298 (Part 2): 2011 are suggested. But it will restrict kneeling while working. Wader shoes can be looked upon as a possibility
Face mask + Air Purifier gas mask/chin cortege	Half-face mask with suitable National Institute for Occupational Safety and Health (NIOSH) certified acid vapour cartridge to be used while opening the lid. The main body can be used for a lifetime, but the canister must be changed as soon as the indicator goes black
Chlorine mask/Breath mask	Breath mask with N 99 or N 100 efficiency can be used. This N type respirator will work for all situations
Gas monitor (4 gases)	Multi gas meter to be used to check the presence of oxygen, hydrogen sulphide, carbon monoxide and methane. The practice of igniting paper and dropping it inside is to be stopped as methane can cause it to explode. The practical difficulty is who is going to do the atmospheric testing and how it will be issued to each vehicle as it costs about Rs 50,000 per piece. A cost-effective option is to do forced air ventilation (explained below)
Air compressor for blower	The desludging vehicle already has this feature. It is recommended that if poisonous gases have been detected (or even if not) in the septic tank, then the forced air ventilation technique be used through the existing feature in the desludging vehicle. It involves blowing plain air into the tank, after the tank is open, so that all poisonous gases can come out. It will also decrease the time that the workers spend (15-30 minutes) to wait for the poisonous gases to come out
Barrier cream	Kerodex hand protection cream is widely used in industries while handling hazardous substances. The same can be used here.
Lead acetate paper	Not advisable as this method is possible only in a lab environment
The items listed below are safety gear to be used for getting inside the septic tank. The study has not considered it under its purview, but information has been provided	
Full body wader suit	The worker must wear nitrile-coated full body coverall while entering the septic tank
Nylon rope ladder 5 metres	To be used while getting inside the septic tank. Both nylon and polypropylene rope can be used
Nylon safety belt	To be used while getting inside the septic tank. Same as safety belt, safety body harness. The safety body harness must be of IS 3521: 1999 and KARAM brand only, and only that must be bought
Safety belt	To be used while getting inside the septic tank. Same as nylon safety belt, safety body harness. The safety body harness must be of IS 3521: 1999 and KARAM brand only, and only that must be bought

Name	Requirement/Reason by Safety Audit Expert
Safety body harness	To be used while getting inside the septic tank. Same as nylon safety belt, safety belt. The safety body harness must be of IS 3521: 1999 and KARAM brand only, and only that must be bought
Airline breathing apparatus ⁸	To be used while getting inside the septic tank. It costs Rs 1.5 lakh, therefore cannot be purchased by the individual worker. It also requires extensive training. So it may not be used
Breathing apparatus	To be used while getting inside the septic tank. The worker has to carry the oxygen cylinder on his back and therefore not feasible.
Source: Safety Audit Expert	

In addition to list of those items not considered which is presented above, the barrier cream, lead acetate paper was replaced by the cone considering storage limitations for operators.

6.3. Rationale for Selection of Safety Gear Sample Kit

The above list of safety gear was verified with process observation and stakeholder's requirements. Based on secondary research and safety expert advice, and observations made during process analysis, the study identified the following body points as *touch points* – referring to body parts that are either partially or completely exposed to or are under the threat of being exposed to sludge, leading to varied degree of hazard for the stakeholder during desludging. The touch points include hands, legs, face, nose, eyes, ears, mouth and the entire body if they clean inside the septic tank, except the face.

As detailed previously, all **stakeholders** agree that **gloves** and **masks** are an absolute necessity for desludging process, while gumboots come a close third. Based on the stakeholders' insights, safety gear were understood to have features as outlined in Table 6.3.

Safety gear	Features	Use/ Utility
Glove	Snug fit	Grip
	Water/leakage/spillage proof	Prevent sludge from touching hands
	Length till elbow with stopper	Protection for entire hand
	All-weather proof	Ability to work in summers and monsoon, since sweating is a big problem
	Tactile feedback for suction hose and instruments	Prevent instruments from falling
	Easy to wear	Save time and effort
	Easy to clean	Save time and effort

Safety gear	Features	Use/ Utility
Mask	Snug fit Waterproof Sound friendly	Prevents inhalation of poisonous gases while opening the tank and inside the septic tank Prevent sweat/ sludge spillage from entering the mouth Allow for communication with co-worker
Gumboots	Water/leakage/spillage Proof Strong grip on all surfaces	Prevent sludge from touching legs; insects and thorns and bushes Ability to walk on all kinds of surfaces on the site

Source: IIHS 2018

In addition to the above gear, safety goggles are required to protect the eyes from sludge due to spillage. Given that poisonous gases are detected based on irritation in the eye, goggles could be a hindrance to gauge poisonous gases inside the septic tank. Therefore, a gas monitor is suggested to detect poisonous gases. Caution tape, caution barriers and reflective jackets are important to let the residents and passers-by know that desludging work is underway in the vicinity and that they must be careful about an open septic tank. Children must be taken care of, especially, and taught to not go near the septic tank through the identification of this safety gear.

Based on secondary research, and informed by the desludging process and the law, which was further validated by safety experts, a sample kit was derived for testing purposes. The safety gear was procured as per recommended standard learnt from secondary sources as well as safety experts. The safety kit post elimination process comprised of the following seven items of gear with variation wherever applicable:

- Gloves
- Masks, 2 types
- Gumboots
- Safety goggles, 2 types
- Gas monitor
- Caution tape and caution barrier
- Reflective jacket

Product details are mentioned below in Table 6.4.

Some safety gear was purchased from shops, others were bought online. Further details on procuring safety gear are mentioned in Annexure 3. While purchasing manually, on one of the trips, a desludging worker was also included, in order to understand his intuitive responses to safety gear. One key insight was that stakeholders relate to safety gear only in the context of entering the septic tank, which is a key consideration which needs to be factored in during awareness and training. Recommended gloves were not procured, because the right vendors could not be identified for the same (and they must be purchased for the next phase). The safety audit consultant articulated a step-by-step safety protocol while wearing and removing safety gear.

Sample Safety gear Kit specifications: -

Safety Gear	Brand	Product Name	Material	Standard	Price (per piece) (INR)	Expiration
Safety goggles 1 (black strap)	Udyogi	NEOLITE	Polycarbonate	EN 166	625	Until the purpose is served
Safety goggles 2 (Blue frame)	3M	1621	Polycarbonate	EN 166	160	Until the purpose is served
Face mask + Air purifier gas mask/ chin cortege	3M	Mask with 6003 cartridge		NIOSH approved	2,400	Face mask can be used for longer durations, but cartridge must be changed when ESLI turns black
Breath mask (respirator/particulate mask)	3M	9,332+	Latex free braided fabric	N95	45	Until colour changes
Hand gloves (nitrile) Available sizes – 7, 8, 9, 10, 11	KARAM Prokem, Honeywell or BSH (local)	HS 101	Nitrile flocklined	EN 374:2016, EN 388	80	Until it tears
Gumboots	Hillson	PVCS G 011	PVC	BIS certified	270	Until it tears
Four gas monitor	Honeywell	Gasalert Quattro	NA	NA	5,4044	Until it tears
Caution tape (red and white)	Any brand	NA	NA	NA	300	After 3 uses
Reflective jacket	Any brand	NA	NA	NA	60	Until it tears
Barrier cone	Any brand	NA	NA	NA	300	Until it tears
<i>Source: IIHS 2018</i>						

6.4. Mock Testing of Safety Gear Sample Kit



The testing of safety gear was conducted in two phases. Phase 1 included testing of all the variations of gloves to understand stakeholder's willingness, as well as develop analytical tools for rating and measuring the effectiveness of the safety gear from the point of view of stakeholder's willingness to use the same. Phase 2, which included all the gear as proposed for safety gear kit above, conducted in four scenarios – three with households and one with a public toilet.

6.4.1. Results from Mock Testing of Gloves

Six kinds of gloves were purchased in sets of two and ranged across a variety of material and brands and specifications. They were purchased locally on the basis of secondary research of KARAM glove products.⁹ Some of the gloves were without a brand name but provided some respite for the issues that desludging workers had raised in their interviews. One limitation is that the kind of gloves that would be ideal for the desludging process have not been procured due to their non-availability in the market.

Three workers were asked to wear and work with gloves and 12 objective questions were asked on – ease of wear, comfort, sweating, ease of using crowbars, ease of opening septic tank, grip while operating valve and lever, grip while taking suction hose from truck, tactile feedback while clamping, comfort in cleaning suction hose, comfort in loading suction hose back on truck and ease of removal. The questions required responses as yes or no and a sum of total yes and no helped evaluate the effectiveness of the gloves for the desludging process. Aggregate responses by three workers to questions and feedback is summarised in Table 6.5.

Table 6.5: Worker Responses to Use of Sample Gloves and Study Opinion

	Analysis	Worker Feedback	Study Opinion
 <p>PVC supported cloth gloves</p>	<p>Yes – 23/30 and No 4/6</p> <p>These gloves were easy to wear and remove due to the loose fit. They are tear resistant and have longevity. The half hand length, and the non-porous material prevents water seepage.</p>	<p>The cloth liner felt good on skin, Not good for tasks involving precision work such as clamping pipe</p>	<p>The glove is easy to wear and remove, but for tasks such as clamping hose it is not suitable</p>
 <p>Grey Neoprene</p>	<p>Yes – 17/30 and No – 6/6</p> <p>Easy to wear and remove, but this feature becomes a disadvantage as it does not aid efficiency of work</p>	<p>It has more elasticity than others, so had to squeeze hand to ensure grip</p>	<p>Safety from injury due to puncture isn't insured. Not much loss in terms of tactile feedback</p>

⁹ CATALOGUED ARCHIVES FOR IIHS_REFERENCE DOCUMENTS_05_SAFETY GEAR RESEARCH_23_Karam_glove range

Table 6.5: Worker Responses to Use of Sample Gloves and Study Opinion

	Analysis	Worker Feedback	Study Opinion
 <p>Red Nitrile Coated</p>	<p>Yes – 23/30, No – 2/6</p> <p>Good fit that provides natural movement of fingers and tactile feedback on the palm.</p>	<p>It was the most comfortable and useful, there was less sweating as it was breathable.</p>	<p>Good protection against most physical injuries, difficult to remove, unable to use mobile phone while wearing</p>
 <p>Orange Nitrile Coated</p>	<p>Yes – 27/30, No – 4/6</p> <p>The fit provides both comfort and ease at work. The thickness of the PU coating provides good resistance to wear and tear. Suitable for work outside the septic tank.</p>	<p>Difficult to dry once washed</p>	<p>Good breathability, dirt sticks more than others. Tactile feedback is lesser than that of nitrile.</p>
 <p>Yellow Rubber Latex Full Hand</p>	<p>Yes – 26/30 and No – 3/6</p> <p>The length is the most suitable feature of this glove. Easy to wash after use.</p>	<p>The length of glove was the good part but it wasn't breathable and there was sweating after use.</p>	<p>Sweat clearly visible on hands, very loose. If dirt goes inside, it will be irritating. Takes more time to clean.</p>
 <p>Blue rubber latex half hand</p>	<p>Yes – 28/30 and No – 4/6</p> <p>The loose fit allows one to remove and wear the glove easily. The smooth surface helps to wash the glove with ease after use.</p>	<p>Tasks like opening levers, moving pipes were not very different after wearing the gloves as they were very thin.</p>	<p>No cushioning is felt, but might be good for jobs requiring tactile feedback.</p>
<i>Source: IIHS, 2018</i>			

As can be seen from the table above, there was a mixed bag of reactions. The unbranded nitrile gloves provided good grip over polyester-lined red and black gloves, allowing for natural movement of fingers and tactile feedback while manoeuvring the suction hose because of the black nitrile coating on the palm. Its snug fit allowed for the tactile connection with the instruments. However, water could enter from the upper palm side. It might not be very sturdy, produces sweating, and is only palm sized. The unbranded 22" yellow glove was preferred for its length obviously but was problematic as it was loose at the elbow. Other gloves had issues of being loose fitting, inducing sweating, being prone to water entering, and insufficient length. These inferences helped to identify the most appropriate glove for the sample kit and establish ideal features that the glove must have.

6.4.2. Results from Phase 2, Safety Gear Sample Kit Testing



The sample kit was tested in order to document the suitability of the gear and intuitive responses of the workers, and understand the amount of time and effort it takes to:




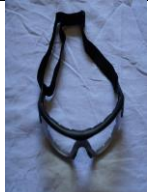
- Make one worker understand how to wear safety gear
- Observe how much he has understood and followed the instructions to wear safety gear when he was left to himself
- Calculate the quantum of time and energy required to make this real on the ground
- Understand the magnitude of problems faced while inculcating the habit of wearing safety gear in the right order and manner.



In addition to above, the study noted the issues that stakeholders might face while working with the gear and the impact of wearing safety gear on the overall performance of desludging from the stakeholder's point of view. The study team did not deliberately impart any information right before starting the test nor did they share safety protocols developed by safety experts, in order to keep the exercise intuitive.

Primary stakeholders were given safety gear (gloves, mask, safety goggles, and gumboots, in that order) and asked to perform the desludging activity with safety gear on. After the gloves were bought, one team of two workers was made to wear one kind of gloves and perform the activity of desludging. The study team observed them and at the end of it, asked for their responses and recorded them. In the next activity of desludging, they were given another set of gloves to work with, and the entire process was repeated and responses were recorded.

The intent of this exercise was to understand and record the intuitive response of primary stakeholders, based on their requirements and understanding of usability of safety gear for this profession. Based on observations, safety audit experts, and secondary sources, the study listed ideal features that the safety gear must have in order to protect the workers from hazard. A set of questions were then developed in order to take feedback from the workers on how the safety gear fared against each feature. For example, if the ideal feature for gloves was that they should have good grip to move heavy cement slabs, the corresponding question was – were you able to move heavy cement slabs while wearing gloves? Using the above analysis, the study arrived at overall suitability of the safety gear against the ideal features, and inferences from testing are presented in Table 6.6.

Table 6.6: Results of Field Testing of Sample Safety Gear Kit Along with Ideal Features		
Safety Gear	Analysis	Ideal Features
 <p>Hand gloves</p>	<p>The identified gloves work well for most of the tasks, except it is difficult to find the left and the right hand of the pair. Sometimes as the workers are not used to working with the gloves, they get stuck while clamping the suction pipe to the tank. The gloves are good for work outside the septic tank, it protects their hands from spillage while removing the pipe from the septic tank and while opening and closing the septic tank lid. The half hand length is not suitable while washing the pipe after use.</p>	<ul style="list-style-type: none"> Have good grip to move heavy cement slab Have physical protection for hands from rough surface Protect hands from touching sludge Provide good fit Provide tactile feedback while holding tools and suction hoses Be water and spill proof Be tear resistant Should not get caught in between tools Be easy to wash and quick to dry
 <p>Gumboots</p>	<p>Gumboots work very well for tasks outside the septic tank, provided the boot size matches foot size. Oversized gumboots make movement cumbersome. They do offer protection against toe or foot injury caused due to uneven surfaces and insect bites. At the same time they are not seen as must-wear safety gear throughout the process. They are required when the workers have to wade through thorns and bushes to bring the suction pipe to the septic tank or to connect the pipe to the vehicle. There are chances of water entering the gumboots while washing the pipe after use.</p>	<ul style="list-style-type: none"> Cover legs (toe to knee) Be snug fit Weatherproof Slip resistant Lightweight Easy to wear and remove Provide cushioning and arch support Have puncture resistant sole Should be comfortable for climbing ladder

		<p>Should be comfortable for walking</p> <p>Should cover legs (from hip to knee) to prevent pipes direct contact with body</p>
 <p>Respirator</p>	<p>Canister mask, otherwise called the respirator, is attractive gear among many others for the worker. With the right fit, this mask can prove effective to protect one from inhaling toxic septic tank gases. Not all goggles can be worn along with this. Communication was possible with this mask.</p>	<p>Prevent poisonous gases from entering nose and lungs</p> <p>Protect from sludge spillage entering the mouth</p> <p>Protect from dust</p> <p>Fit snugly</p>
 <p>Breath mask</p>	<p>Mask offers good protection from inhaling dust and some protection from inhaling bad odour. As the form of the mask is not defined as that of the respirator, the fit depends from person to person and the handling of the mask. It also offers protection from swallowing the contaminants.</p>	<p>Protect from sludge spillage entering the mouth</p> <p>Protect from dust and germs</p> <p>Be snug fit</p>
 <p>Safety Goggles Style 1</p>	<p>The model of goggles, can only be worn with the mask and not with the respirator due to its large size. It offers clear cone of vision, and protects the eye from gas irritation, hot air that escapes the septic tank, dust, mist and splashes. The elastic holds the goggles firmly and prevents it from falling.</p> <p>However, owing to hot weather and high humidity, there is constant sweating both inside and outside of the goggles. Wearing the goggles does not allow the wearer to wipe his sweat. The worker often removes the goggles and leaves it on his head to be worn at his convenience and need.</p>	<p>Not hinder vision</p> <p>Not hamper communication</p> <p>Not fog up</p> <p>Not slip out of his head when bend down</p> <p>Prevent sweat from trickling into the eye</p> <p>Protect from dust particles</p>
 <p>Safety Goggles Style 2</p>	<p>Though this goggles, can be worn with the mask as well as the respirator, workers intuitively picked up the other goggles, perhaps for its more robust looks. The merits of this model is that, the area it covers is just right, that it does not allow as much fogging or accumulation of sweat. It also protect the eye from septic tank gases.</p>	<p>Protect from gas irritation</p>

	<p>The reflective jacket offers safety by indicating that work is in progress. Although workers say that it is more useful for work at night. Open size fits all.</p>	
<p>Reflective Jacket</p>		<p>Barricade the area</p> <p>Place a safety grill on the lid</p> <p>Must be accompanied with a sound and light indicator</p> <p>Must be accompanied with a Work-in-progress indicator</p>
<p>Cone and Caution Tape</p>	<p>Source: IIHS 2018</p>	

Gloves: KARAM Prokem, Honeywell or BSH hand gloves (nitrile) (HS101)

Safety expert and safety protocols suggest that nitrile gloves must not be used while opening and lifting slabs, but only for emptying the septic tank. The study has allowed the gloves for breaking up the slab and opening the lid and documented feedback for the same. Nitrile gloves were difficult to wear for the first time, they did induce sweating, but a little later than other gloves (based on testing of gloves conducted in Phase 1).

As can be seen in the table, the gloves did not hamper any desludging activity due to their material, fit or any other design feature. The only limitation identified was the short length resulting in water and sludge seeping onto their hands through the opening. The half hand length is not suitable while washing the pipe after use and hence elbow-length gloves are a must for the next phase of testing.

Figure 6.1: Image of Safety Gear – Respirator, Particulate Mask, Gas Monitor, Gloves, Gumboots, Jackets Being Tested

scenario 3, household, showing primary stakeholders breaking the lid with safetygears on



scenario 2, public toilet, showing primary stakeholders clamping with gloves, goggles and mask and gumboots on



scenario 3, household, showing gas monitor in use



scenario 3, household, showing primary stakeholders clamping the hose pipe



Source: IIHS 2018

Goggles: Style 1 (3 M 1621) and Style 2 (Udyogi NEOLITE)

There was no mention of safety goggles by the stakeholders as a requirement for the process, because they can identify the presence of poisonous gases when their eyes begin to water or experience irritation. Two kinds of safety goggles were tested: 3M 1621 Safety Goggles (Style 1 blue frame) and Udyogi NEOLITE Safety Goggles (Style 2 black strap).

The 3M 1621 Safety Goggles model can be worn when the absence of poisonous gases is confirmed and is to be worn by the second person (the one who is away from the septic tank and wears a particulate mask).

Udyogi NEOLITE Safety Goggles provided better respite from sweat as it did not allow sweat to trickle down into the eyes, unlike the one mentioned above. This pair of goggles must be worn only with an air purifier mask and by the person who opens the septic tank. The goggles must be worn after confirming the absence of poisonous gases, as wearing it beforehand would add to the hazard by not allowing the wearer to sense eye irritation, which is a signifier of the presence of poisonous gases in the tank. When the stakeholders wore them, they felt comfortable with both the models, and looked at goggles as style statement.

Gas Monitor: Honeywell Four gas monitor – Gasalert Quattro

A gas monitor was used for detecting poisonous gases in the tank during testing. Considering that all the septic tanks during testing had vent pipes, the gas monitor was of limited use. Its effectiveness is to be further validated in extreme situations only. The workers expressed their curiosity and interest to use the monitor. Considering the given interface, the product requires training and needs to be used with due precaution.

Gumboots: Hillson Gumboots PVCSG 011

Gumboots provide protection against foreign objects on the ground and offer comfort while walking but failed to resolve issues of water entering the boots while washing pipes. The workers prefer gumboots during the monsoons only and require open footwear that should be easy to dry, because if sludge enters the shoes, it can cause infections. Gumboots or the right footwear requires further detailed observational testing to validate the suitability of the same for the desludging process.

Masks: 3M Face mask + air purifier gas mask/chin cortège with 6003 cartridge and 3M Breath mask (respirator/particulate mask) – 9332

The 3M Face mask model works well for desludging operations in household septic tanks. But air contaminants are not known for septic tanks in commercial places, such as industries, hotels, colleges, schools, community halls, and public toilets. The model offered protection from poisonous gases even when the worker is near the septic tank and prevents inhaling of gases as well as contact with sludge. The canister has to be changed after the ESLI turns black for its effectiveness.

3M Breath mask (particulate mask) – 9332 model can be worn by the second person (the one who is away from the septic tank). This must not be worn by the one who is opening the septic tank. It has to be worn by one person only and must be changed once the colour changes.

Both the masks were well received by the workers. The two major issues of sweating and suffocation have been addressed by the two gear recommended by the study. The workers have to be trained for its use, maintenance and care to ensure the gear itself does not become a threat.

Reflective jacket

The reflective jacket offers safety by communicating that work is in progress. The jacket is suitable for use as is. However, the ULB desludging operators have complained they were being treated improperly by tea vendors, because of the stigma associated with the orange colour; as people know that this is

for cleaning staff. Private operators prefer to wear it in case of work at night, because of its light emitting quality. They do not see it important during the day and this needs to be addressed during training.

Barrier cone and caution tape

The barrier cone works as a work-in-progress indicator near the vehicle. The caution tape did not find much use because it is not legible from a distance. During the testing, primary stakeholders did not find much use for both. A barrier cone by itself does not solve the problem of tertiary stakeholders accidentally falling into the septic tank. The study recommends other ways to create alertness to the situation, through light and sound alternatives and requires detailed study.

One of the workers refused to wear safety gear because it was very hot and induced a lot of sweating. All respondents agreed that safety gear induces more sweating. It is recommended that the next phase of safety gear testing be done in the worst-case scenario – the summers and monsoons, to find the best possible answers for the right safety gear.

The study suggests that a walkie-talkie, a torch with wearing gear and protection for the thighs and ears be incorporated in the next phase of testing. The mock testing has helped validate the suitability of gear for the desludging process, however the same was done for a cycle of desludging activity. In order to further articulate complex issues of repeated usage, how to wash and dry gear, where to store it, how many are required in a week's duration, and the longevity of each piece of gear, multiple pilots are required in order to implement the safety gear kit on the ground along with standard operating protocols for using the same. The study made an attempt to understand the same with the help of a safety audit expert.

Annexure 3 presents a summary view of the hazards at in various stages of the desludging process, and the safety gear recommended by law and perceived need by workers along with the recommendations of the safety experts.

6.5. Safety Protocol and Standards of Operation: An Attempt

SOPs, are step-by-step instructions that act as guidelines for employee work processes. They consist of clearly documented, step-by-step procedures and checklists that are easy for employees to follow and greatly reduce the chances of mistakes. Whether written up in numbered steps or formatted as flow charts, effective SOPs are based on input from the workers who do the job. Standardised procedures guide workers, create consistency and protect the integrity of a product.

In desludging operations, an unorganised sector, the need to safeguard workers from hazards has led to the need for using safety gear. Wearing safety gear is not just a simple activity; it requires procedural intervention. If any step is not followed properly, there are greater chances of contamination through the use of safety gear. Therefore, it requires adequate and thorough teaching and training in:

- How to wear them
- How to remove them
- How to dispose them off
- Sequence of wearing and removing them
- Complete understanding of benefits and limitations of each kind of safety gear

This will aid in minimising hazards in terms of safety, increasing productivity, reduction of defects and supporting peer accountability and coaching.

Based on its secondary research on standards and brands and imperative of safety protocols and measures, the study, with its safety audit consultant, attempted to define safety protocols; just to gauge how the whole process of developing and executing SOP and safety protocols will work on the ground.

The safety audit consultant was shown the desludging process in three different contexts as it happens on the ground, so that he could provide informed solutions. The study has put its primary focus on wearing and removing the safety gear in the sample kit.

6.5.1. Sequence of Wearing and Removing Safety Gear

The consultant has also developed protocols for wearing and removing safety gear.¹⁰ In the figures below, he provides instructions to the worker on the chronology of wearing and removing safety gear (that became the basis for mock testing of safety gear). This is the **sequence of safety gear to be worn is as follows:**

- Reflective Jacket
- ↓
- Gumboots
- ↓
- Gloves
- ↓
- Mask
- ↓
- Goggles

The **sequence of removing safety gear** is as follows:

- Mask
- ↓
- Goggles
- ↓
- Gloves

Figure 6.2: Steps to Remove Mask	
4. MASK OR RESPIRATOR	
<ul style="list-style-type: none"> • Front of mask/respirator is contaminated — DO NOT TOUCH! • If your hands get contaminated during mask/respirator removal, immediately wash your hands or use an alcohol-based hand sanitizer • Grasp bottom ties or elastics of the mask/respirator, then the ones at the top, and remove without touching the front • Discard in a waste container 	
Source: https://www.cdc.gov/hai/pdfs/ppe/ppe-sequence.pdf	

¹⁰ CATALOGUED ARCHIVES FOR IIHS_ SAFETY GEAR_VD_91_SAFETY_AUDIT_OFFICER_EXPLAINS_SAFETY_PROTOCOLS_TO_WORKER

Figure 6.3: Steps to Remove Goggles

2. GOGGLES OR FACE SHIELD

- Outside of goggles or face shield are contaminated!
- If your hands get contaminated during goggle or face shield removal, immediately wash your hands or use an alcohol-based hand sanitizer
- Remove goggles or face shield from the back by lifting head band or ear pieces
- If the item is reusable, place in designated receptacle for reprocessing. Otherwise, discard in a waste container

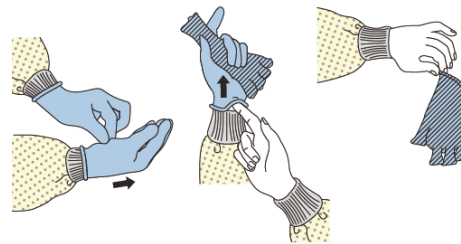


Source: <https://www.cdc.gov/hai/pdfs/ppe/ppe-sequence.pdf>

Figure 6.4: Steps to Remove Gloves

1. GLOVES

- Outside of gloves are contaminated!
- If your hands get contaminated during glove removal, immediately wash your hands or use an alcohol-based hand sanitizer
- Using a gloved hand, grasp the palm area of the other gloved hand and peel off first glove
- Hold removed glove in gloved hand
- Slide fingers of ungloved hand under remaining glove at wrist and peel off second glove over first glove
- Discard gloves in a waste container



Source: <https://www.cdc.gov/hai/pdfs/ppe/ppe-sequence.pdf>

Once past the hazard of poisonous gas, the worker can change from an air purifier mask to particulate mask. If required by the process, the worker must wear safety goggles.

Gumboots can be worn throughout the day, but must be worn during the process.

The reflective jacket must be worn throughout the day, from the moment they get in the vehicle, till the work is over. The neon colour of the jacket allows for people to see the desludging worker and make them aware that this work is in progress.

Selection of safety gear has to take into account the proper wearing and fitting of the equipment. Every stakeholder must be personally able to choose the size and fit of recommended safety gear. Safety gear must be user-friendly and fit the individual worker perfectly.

Special care should be taken where persons suffer from certain medical conditions, e.g. certain types of respiratory protective equipment (RPE) may not be suitable for employees with asthma, bronchitis or heart disease. Such people must be prescribed safety gear after understanding their medical condition. All safety gear must be certified by the prescribed standards as indicated in the sample kit for safety gear. The standards signify that each kind of safety gear satisfies certain basic health and safety requirements. Caution must be taken not to buy fake or unbranded products in the market, just to save money.

6.5.2. Disposal

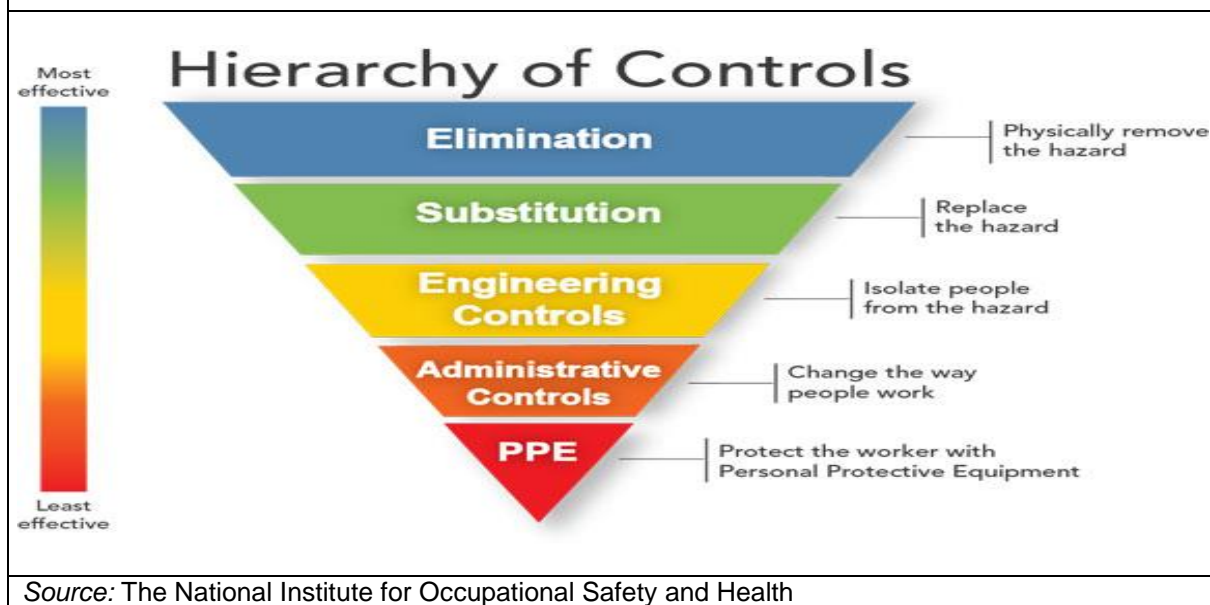
The study, at this stage establishes the need to consider disposal as a very critical aspect of using the safety gear. Disposing of safety gear is a predefined activity in controlled environments, the workers are aware of a designated place for disposal. However, the same is not applicable in the context of

desludging activity and requires resolution during the next phase of testing proposed for a longer duration.

7. Way forward

As per safety experts, there are five methods to control any hazard, also called the hierarchy of accident prevention:

Figure 7.1: Hierarchy of Controls



- Elimination: If the work is hazardous, that work should be eliminated
- Substitution: If it is not possible to eliminate that work, then machines must be used for that purpose
- Engineering control: Gas testing, or any new machines
- Administrative control: Licenses, training, protocol, work permit system, induction, medical health check-up and surveillance
- Safety gear: If the above four fail, then safety gear must be resorted to.

Informed by analysis, inferences, opinions and concerns, the study helped identify opportunities at a preliminary stage in terms of intervention. Based on the same, the study recommends the following way forward through the three thematic areas of **Mitigation** to include elimination and substitution, **Prevention** to include administrative and engineering controls and **Protection** across various tangents. All the above steps help in understanding and charting a further course of action across the domains.

Creating awareness about health and safety risks and hazards is a mitigative measure. Furthermore, changes in the desludging process might lead to mitigation of health and safety hazards. Protocols in the form of operative guidelines, laws and acts, can act as preventive measures. Protection can be seen in terms of usage of safety gear. Testing of safety gear validates the willingness to wear safety gear in desludging operations and its suitability.

7.1. Mitigation

Mitigation is the effort to reduce loss of life and property by lessening the impact of hazards. It involves identifying and creating measures to reduce hazards, both for short-term and long-term periods, for an

effective insurance over any loss. Here mitigation is sought through elimination and substitution by creating behavioural change through awareness programs, both for primary stakeholders and the general public.

In the city studied, mechanised cleaning of the septic tanks is common, although in various situations primary stakeholders do enter the septic tanks, which exposes them to grave hazard. The three key hazards they are exposed to include hazardous gases, risk of physical injury and direct contact with sludge, given that they seldom wear safety gear. Entry into septic tanks is for various reasons including clients wanting their septic tanks 'fully' cleaned or workers volunteering to 'fully' clean the tank for extra money, blockages in the tank due to dumping of non-biodegradable items, and sometimes genuine maintenance work required in the tank. The primary aim of the mitigation strategy is to prevent the entry into the septic tank by accident or avoid entry on purpose wherever it can be completely avoided.

7.1.1. Elimination

Elimination strategies are aimed at removing the process, material or component that is causing a hazard.

An open and unattended septic tank should be cordoned off

Newspapers abound with news of people, especially children, falling into septic tanks, which can be completely prevented. During the process of desludging, the septic tank is kept open for a duration of 5–30 minutes, to let the poisonous gases evaporate. Sometimes the tank is kept open, while the workers and drivers go the decanting station to empty the vehicle tank. It is here that the tertiary stakeholders (the client and his family) are at maximum risk. The maximum number of accidents happen in this window. The study proposes the use of barrier cones, caution tapes and safety jackets to create awareness among passersby about the hazardous activity nearby. These are included as a part of the safety gear sample kit to help avert this situation, this issue must be taken up with great urgency on a mass level.

Awareness campaigns to avoid throwing non-biodegradable objects in toilet

The biggest reason for blockages in septic tank is the presence of foreign objects such as sanitary napkins, condoms among others. These objects are thrown and flushed away, as there is stigma and taboo associated with them or lack of an appropriate disposal mechanism to trash them. However, this must be corrected at the societal level by educating them on the harms and hazards of these actions on workers' health and safety. This must be done through creative awareness campaigns on newspapers, television, radio and social media.

Awareness campaign about NOT cleaning septic tanks

In this context it is important to eliminate the hazard of getting in to the tank altogether when not required at all, such as for a 'full' cleaning of the tank or for wanting to make extra money, which is particularly observed when owner-cum-drivers are engaged in the cleaning process. Towards this end, clients need to be made aware that it is actually not required to 'fully' clean the septic tank and on the contrary it is important to leave some sludge behind to facilitate anaerobic digestion. Also, self-regulation by primary stakeholders through improved awareness of the risk of exposure to hazard, besides better enforcement of the law, is required. Improved oversight on the part of government officers would also lead to better compliance with the law.

Although not directly classified as elimination, one aspect that needs to be addressed is that certain owner-cum-drivers cheat their clients about their vehicle capacities and the volume of the septic tank in order to make more money. Thus, building client awareness on the desludging process, vehicle and septic tank capacities could protect them from being cheated.

7.1.2. Substitution

Substitution strategies aim at replacing the process or material with less hazardous alternatives.

Awareness campaign to promote regular desludging

Usually, people call for desludging services only when there is backflow in the toilet or when they begin to smell bad odour. Also, desludging services are expensive for some people and are avoided by them as much as possible. These are dangerous situations though and must be averted at all costs. BIS standards ask for septic tanks to be cleaned once in 2–3 years, although in reality it is not followed. Clients must be made aware of this aspect too. Joint booking of desludging trucks by neighbours and cost sharing can be pursued.

Awareness about NOT using cleaners and detergents

In today's time, chemicals in the form of toilet and bathroom cleaners, shampoos and detergents, mix with sludge. This makes the sludge (even from the households) very dangerous for the health of desludging workers, as they come in contact with sludge. Awareness must be created about such products. It is known that these products are made by large fast-moving consumer goods (FMCG) companies who spend a lot of revenue on advertising, impacting people's decisions to buy certain kinds of products. Therefore, a direct mass media campaign might not be very beneficial. Campaigns that focus on word-of-mouth publicity or personal interactions might prove to be more helpful to mitigate this challenge. Another option is to promote bio-enzymes as a cleaning method. This will also initiate the scope for a new enterprise, as more people might take on to this idea and process.

Increasing stakeholder awareness of issues is the only solution. Relevant ministries of central and state governments can commission information material to create awareness on these issues. In this context, audiovisuals on TV and social media, advertisements in newspapers and on social media, paintings and hoardings on walls may help. A separate media research, strategy and campaign can also be planned for the same.

7.2. Prevention

The next step in the hierarchy when hazard cannot be mitigated is to look at prevention measures. Prevention refers to any action designed to impede the occurrence of a disaster event and/or prevent such occurrences from having harmful effects on any sector, community or the general masses. This includes actions through both administrative controls and engineering controls. While administrative control reduces or eliminates the hazard by adherence to procedures, engineering control approaches the same through structural changes to the process or work environment.

7.2.1. Administrative Controls

Administrative measures are required for ensuring health and safety among primary stakeholders. The administration being referred to here is the corporation administration.

- The administration must ensure that all legal standards, health and safety standards, and environment related issues are addressed immediately and all rules and regulations are observed and abided by.
- The corporation could hold awareness camps to update them about latest technological interventions.
- Free-of-cost medical camps could be held for the primary and secondary stakeholders. A counsellor or a psychiatrist may also be involved in these medical camps, to encourage them to discuss their psychological and emotional well-being.

- The corporation has organised many seminars and exhibitions for awareness on the use and promotion of safety gear. There is a need to organise these seminars and exhibitions more frequently. The younger generation among primary stakeholders must be actively sought out and the imperatives of using safety gear must be impressed upon them. They might adapt to use these safety gear faster than their older counterparts.
- The corporation must ensure that the workers and drivers wear the prescribed safety gear before beginning to clean the work. On-site safety standards must be explained to the workers through seminars, meetings and training programmes and it must be ensured that they follow all required instructions. Advertisement campaigns across media – newspapers, TV, banners, print-outs – could be effective means to explain the importance of safety and following safety standards. On-the-spot checks can be conducted while the primary stakeholders are at work on-site, and fines could be imposed on them if they don't follow safety standards. Even though it may be a fear-inducing exercise, it could be an effective means to ensure the safety of the workers.

In this context, protocols are defined as a special and specific set of rules that are created to address prevention of hazards at the work level. Protocol can be understood and addressed at the following levels:

Recognition in Law and Policy

Desludging operations have been included in the larger domain of sanitation work or FSM. But whenever there is any discussion on sanitation, it has been found that desludging operations do not find much space in this domain. On the other hand, they are the only human element in the process chain of FSM (the Primer on FSSM, issued by the MoUD, is just one example). While developing policies around sanitation and FSM, it might be a good idea to elaborate on the human element of desludging workers, the issues they face, and solutions must be articulated to make this occupation a dignified one. Though it is a long-term policy intervention, separate recognition for desludging operations would help in establishing it as an organised practise. This might also help in addressing legal issues with the act of getting inside the septic tank in the long run.

Standard Operating Procedure

It is important to draw up an SOP which will offer step-by-step instructions to carry out operations correctly and always in the same manner. This helps workers carry out complex routine operations. In the context of desludging operations, a detailed SOP that includes wearing and removing of safety gear, assessing of poisonous gases, precautions to not inhale poisonous gases, and removal of blockages while averting any kind of hazard, must be articulated. The same is to be adopted by operators at an organisational level.

Safety Standard Manual

As a part of this study, a detailed list of on-site steps and procedures has been drawn up and touch points on the human body and hazards have also been identified and mapped. The study has established that desludging operations are different from other works of sanitation and must be treated as a separate activity in the larger realm of sanitation. Findings and studies based on sanitation and sanitation workers have not been found valid for desludging operations. In the same way, existing safety standards for industries and other organised sectors have been found inadequate for desludging operations. The study suggests that a separate scientific study be conducting for understanding the safety hazards in greater detail, and based on the findings, a separate Safety Standard Manual which focuses on the safety standards for desludging activities be prepared with the help of experts. This is envisaged at a city corporation level and should be implemented by the administration.

It is also important to draw up an emergency protocols in the event of accidents and stakeholders need to be trained in the same in addition to formulating emergency protocols.

Code of Practice

All countries recognise the importance of OHS standards in desludging and FSM. Kenya is working on OHS standards for both public health and the pit-emptier associations. Bangladesh and Indonesia have started to develop SOPs.

Desludging operations in the state chosen for study are in the unorganised sector. Dominated by a certain community which has been engaged in manual scavenging for generations, they do have their informal, but tried and tested, means of conducting desludging operations. They have also made very effective use of technology to improve their operations.

To ensure that the primary stakeholders do not suffer from any OHS hazard, desludging operations must be codified and a Code of Practice must be articulated. A Code of Practice will enable the achieving of health and safety standards required under the legislation for the primary stakeholders. It will also provide guidance on effective ways to identify and manage health and safety risks. Information and awareness should come well before inspections and penalties. It seems important that all stakeholders, governments, and clients are informed and involved in some way, to contribute to a culture of safety. The Code of Practise is being proposed as a state-level, if not national-level, activity.

7.2.2. Engineering Controls

The study has understood that many safety hazards related to the tank, tools and equipment can be prevented by interventions in design at this level. This might be very time-consuming and take up to 5 years, but immediate efforts must be taken for future prevention of tragedies.

Septic Tank

As explained earlier, the two-compartment septic tanks are no longer constructed and have given way to one-compartment tanks. Thus, what is referred to as 'septic tank' today is nothing but a holding tank with liquid, solid and chemical waste (and kitchen waste, in the case of hotels and restaurants).

While the BIS specifies guidelines for the construction of septic tanks, it does not take into account the safety of workers. Based on the study, it is proposed that a slope in the septic tank might help to suck out the sludge. It could be made a part of septic tank design and implemented in new constructions.

The current location of the inlet pipe does not allow access from the outside. The location of the inspection chamber in the same place as the inlet pipe will allow visual and physical access to address blockage.

The septic tank design could be revised with the above-mentioned parameters to address safety at a design level.

Entering the septic tank to clear blockages has been identified as the primary source of hazard in the process and the most critical one to address. This can be prevented with the introduction of specific tools to remove blockages without having to enter. These tools work on the principle of force or force combined with drilling, thereby ensuring that even the most stubborn blockages can be cleared. Companies¹¹ producing such tools in India can be collaborated with and their efficacy for the desludging

¹¹ <http://www.kamavida.com/product-list.php>

process can be gauged. Based on this interaction, a future course of action can be charted, whether the development of a new tool is required or not.

Figure 7.2: Tools for Clearing Blockages in Septic Tanks



Source: <http://www.kamavida.com/product-list.php>

Process Intervention

The process of lid opening, accessing the septic tank, and tools required to open the lid and remove blocks require process intervention as an independent exercise through scenario building, and can lead to innovative solutions in the long run and must be explored not only to eliminate hazard but also to make the act of opening the lid a more humane and effective task with respect to ease of opening, time taken to open, interaction with sludge, etc.

Vent Pipe

At certain places, it was observed that vent pipes were not at adequate heights. It was also recorded in casual conversations that some septic tanks don't have vent pipes at all, thereby aggravating the problem of poisonous gases.

The height of the vent pipe must be 8 ft above the roof to prevent inhalation of poisonous gases and must have a cowl to prevent foreign objects (bird shit, plastic, hair, etc.) from entering the pipe.

Research may be done to explore if poisonous gases can be removed through the vent pipe using certain mechanisms. After that, design intervention for such a product may be undertaken.

Lid Design

Many stakeholders have suggested (based on what they have been observing in the city vis-à-vis apartments, which produce grey water sludge) that there should be no lid and only a 1 ft x 1 ft hole should be provided for letting the suction hose in. This eliminates completely the possibility of entering the tank just for cleaning purposes. However, this design doesn't address the problem of blockages.

Across the world, many innovations have happened at the level of septic tank lid design, the most popular among them being the septic tank riser or access port. For those septic tanks which are buried in the ground, risers are installed on them to bring the lid to ground level. They are available in varying diameters from 6–36 inches.

Figure 7.3: Septic Tank Riser



Source: www.aztecseptic.com/septic-tank-system-installation.php

Other secondary options, like netting, mesh and grating are also thought of and are in use internationally to add another layer of safety inside the septic tank lid. These could be procured and tested as samples to evaluate their efficiency in the Indian context.

Figure 7.4: Secondary Options



Source: www.onsiteinstaller.com/online_exclusives/2014/05/septic_tank_safety_risers_lids_save_lives

Households in the city don't follow any standard while constructing septic tanks, and this creates many problems in accessing and cleaning. Opening the slab every time to clean the tank may cause injuries to the workers. If there can be a standard variant lid design in terms of cleaning, a lot of safety-related hazards can be averted. Dedicated design intervention may be conducted for arriving at a standard lid design for the city and (Indian) contexts. Local fabricators can be roped for producing them at mass levels. According to the study, the standard lid must have the following features:

- Prevent breaking the slab every time the tank gets cleaned
- Prevent injuries while opening and lifting the slab
- Have enough space for a maximum of two pipes to get into the septic tank
- Be structurally strong for anticipated loads
- Easily removable by adults but impossible to remove by very young children
- Allow for air blowing through suction pipe in the septic tank, so that poisonous gases can escape from the lid and there will be no need to open the slab

Vehicle

The workers revere their vehicle as it their source of income and means of livelihood. They revere it to such an extent that they don't use slippers while driving their vehicle as a mark of respect. The stakeholders clean their vehicle every day, desilt and clean it from the inside every month and paint its interiors once a year.

However, it was observed that some vehicles had loose inlet valves and clamps, which has led to spillage of leftover sludge from previous works. These loose valves and clamps do not allow for proper suction. The workers can be splashed with sludge, which might not be good for their eyes and mouths. Regulatory measures can be adopted to check the health and maintenance of the vehicle. A dedicated service centre for desludging vehicles may be operated by one of the primary stakeholders.

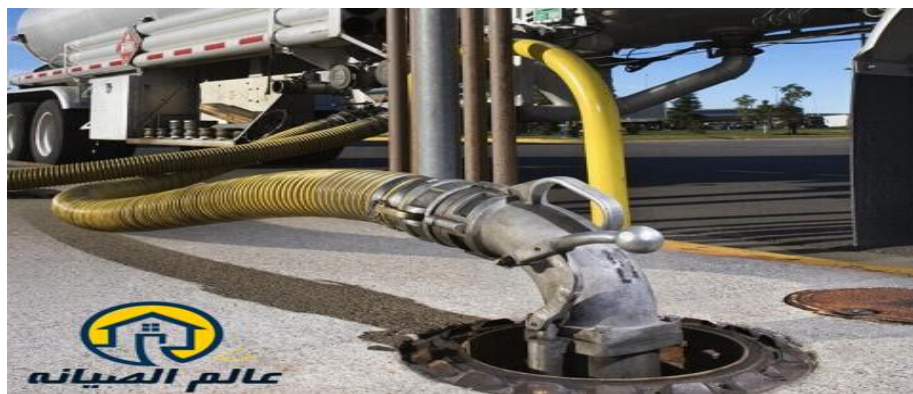
Tools and Equipment

The vehicle has as much as 100 ft of suction hose, and tools to open septic tanks including crowbars, and for removing blockages, etc. It has been pointed out that it might not be the gloves that are unable to provide grip; sometimes the suction hoses have grown so old that they lose their abrasion resistance and are unable to provide grip. There could be checks to ensure that all suction hoses and other tools are changed once they exhibit such wear.

Workers come in contact with sludge while clamping the hose to the vehicle and connecting pipes. This safety hazard has to be averted through a mechanism intervention at two points:

- When the hose is clamped to the vehicle
- When the hose is taken out of the septic tank

Figure 7.5: Handle to Prevent Contact with Sludge; Reference Image



Source: <https://hutbephot247.com/category/dich-vu-hut-be-phot/page/13>

To prevent workers from touching sludge, the study proposes product research and design intervention in the vehicle and hose. The design of the spout, handle of trucks/dip pipe, and clamp, the storage of equipment, and the operation and maintenance of the vehicle need to be looked into. This study might take a longer period of time, but new vehicles can be equipped with these mechanisms. Solutions must also be found to incorporate these mechanisms in existing vehicles too.

Air Blowing Poisonous Gases

Both the vehicle and the suction hose can be cost-effective means of getting rid of poisonous gases in the tank. It is called the air blowing technique and the desludging vehicle already has this feature (which is used for to liquidify sludge and add water later for easy suction). The air blowing technique is used in large septic tanks by BHEL, and was shared by safety officers at BHEL. It involves blowing plain air into the tank after it is opened, so that all poisonous gases can come out. Besides removing poisonous gases, it offers the added advantage of reducing time spent (by 15–30 minutes) waiting for the poisonous gases to come out.

The efficacy of this technique must be tested for septic tanks in the context of desludging. If effective and successful, this could be included in the standard of operations.

Decanting Station

There are four decanting stations in the city. As they wait for their vehicles to empty, the primary stakeholders do spend some time at decanting station, socialising, chatting, or even having lunch.

It has been proposed by the respondents that there could be a toilet and bathroom for bathing and freshening up. Stakeholders have also asked for an angular slant on ground near the decanting well, so that the vehicle can empty completely without much use of the suction motor (This has to be vetted with a study, as its efficacy is not gauged). They have asked for at least one more decanting station near the city as other decanting stations are far away, adding to their operational costs which they have to pass on to their clients (sometimes they cheat their clients in order to make more money on this pretext).

If the workers are injured, they treat themselves with local remedies (such as putting sand on an injured leg), until they see a doctor for complete treatment. These demands can be taken up with the corporation and be undertaken through proper procedures. First Aid and basic medical facilities including stationing a doctor could be instituted at decanting stations, which they are sure to visit after desludging.

Liquidifying Sludge

It has been observed that liquidifying sludge is a time-consuming exercise. There is an opportunity in design and product intervention to save time and efforts either through a tool or a water pressure mechanism. Planned research exercise and design intervention may be undertaken to address this aspect.

Falling and Tripping

The reasons and touch points for falling and tripping have been articulated in Annexure 2. While this is not an actual hazard, the possibility may not be denied and it may be treated as a threat. Efforts could be undertaken to understand the nature and gravity of this threat and future course of action can be figured out.

7.3. Protection

Protection, in the context of the study, is connected with the use/non-use of safety gear in desludging operations. An elaborate exercise for reaching at the ideal safety gear for desludging process has been done and explained in the preceding pages. Safety gear is considered to be least effective in the prevention of a hazard because it does not control workplace hazards, but only protects the wearer.

Safety gear have their limitations because:

- They only protect the wearer.
- They are ineffective if not working or fitted properly
- Theoretical levels of protection are seldom reached in practice
- The use of safety gear always restricts the wearer to some degree
- The psychological effect of safety gear may be such that the individual wearing the safety gear feels more protected than he or she actually is.

Given these limitations, the safety gear must only be used as a last resort.

Successful safety gear execution and implementation exercises will have to incorporate the component of behavioural change among primary and secondary stakeholders – desludging workers, drivers and owners, and society.

Awareness campaigns for primary stakeholders:

Awareness for willingness to use safety gear

Many reasons have been cited for not using and wearing safety gear. The ergonomical issues shall be addressed through design. However, there is great unwillingness and resistance to wearing safety gear. This aspect has to be delved into in greater detail, so that the root cause is identified and solutions are designed bearing those considerations in mind. Subsequently, training programmes can be conducted and repeated at regular intervals in order to reinforce willingness. The issues related to mindset as elaborated in chapter 5 must be woven into the awareness programme. Training is required to follow SOPs and safety gear protocols.

During mock testing, it was observed that if safety protocols and SOP are not explained and diligently followed, then the efficacy of the safety gear will be negative. This will be a major exercise in itself and has to be reinforced through regular training. A separate study should be undertaken on how this aspect of behavioural change should be brought about on the ground. Workers need to be trained to follow safety protocols in addition to addressing how to use the safety gear.

Personal hygiene and safety and health hazards

Reinforcement training must be conducted on personal hygiene (One NGO has been doing it in the slums, for the past 20 years) as a reinforcement exercise. It has been observed that the older generation practices good hygiene, but the younger generation, the new entrants, think of themselves as immune to disease and do not take meticulous precautions. Trainings should be designed in such a way that both elderly and young are engaged in an informative way. There could also be a detailed study on how this problem can be resolved through Information and Communication Technology together with an NGO.

The decanting station could be thought of as a place where the imperatives of safety and health can be imparted and discussed. Since all peers connect with each other in the neutral environment of the decanting station, it might be a very good space to create awareness and educate them about correct practices in their occupation.

The decanting station can have safety and health related information – infographics, pictures, drawings, etc. on the following categories:

- Compositions of poisonous gases
- Situations that cause loss to human life
- Health hazards

- Importance of wearing safety gear
- How to wear and remove safety gear
- How to dispose of safety gear
- Personal hygiene

Training and awareness on first aid and emergency protocols

In the context of desludging (apart from the hazards pointed out above), primary stakeholders say that if they get hurt, they undertake some temporary treatment (putting soil over the wound) and still continue to work. They only go to the doctor after they have finished the work. This could lead to infection and other kinds of problems. The study suggests that if the **workers and drivers are provided training for first aid and healthcare, they can reduce the risk of infection** and other health hazards before they go to the doctor for treatment.

Furthermore, clients must be sensitised that if the worker or the driver is hurt, they must help them seek treatment and immediately take them to a hospital. Since the biggest fear here is that the worker or driver might lose the work order, they must be able to assure them they can resume work after they have received the treatment.

It is important that every vehicle has its own first aid kit. Given the complexity of the operation and the skills involved, the desludging operation should be carried out by two persons and never left to one person.

7.3.1. Recommendations for Safety Gear

Based on all mock testing exercises conducted and reported above, certain insights and steps emerge which are document in Table 7.1 and details are provided in Annexure 4.

Safety Gear	Study Insights	Way Forward
Udyogi NEOLITE Safety Goggles 1 (black strap)	This model must be worn only with air purifier mask and by the person who opens the septic tank.	Suitable for use as is Training required for use, care and maintenance
3 M 1621 Safety Goggles 2 (Blue frame)	This model can be worn when absence of poisonous gases is confirmed. This model can be worn by the second person (one who is away from the septic tank and wears particulate mask) This does not fit well with the air purifier mask on the face and must not be worn by the one who is opening the septic tank	Suitable for use as is Training required for use, care and maintenance
3M Face mask + Air purifier gas mask/chin cortege with 6003 cartridge	Both the masks were well received by the workers. The two major issues of sweating and suffocation have been addressed by the two kinds of gear	Study must be undertaken to:

Table 7.1: Insights and the Way Forward with Safety Gear

Safety Gear	Study Insights	Way Forward
	<p>recommended by the study. The workers have to be trained for its use, maintenance and care</p> <p>The present model works well for desludging operations in household septic tanks. But air contaminants are not known for septic tanks in commercial places, such as industries, hotels, colleges, schools, community halls, public toilets.</p>	<ul style="list-style-type: none"> - Identify the air contaminants present in septic tanks in commercial places and public toilets - Determine the air concentration of the contaminant in these septic tanks <p>The study suggests that a respirator gas mask with safety goggles for the full face must also be considered, purchased and included in the next phase of study, to understand the differences (at various levels) between the two models.</p> <p>Based on the recommendations, further directions can be assessed</p>
3M Breath mask (respirator/particulate mask) – 9332+	<p>This model can be worn when absence of poisonous gases is confirmed.</p> <p>This model can be worn by the second person (one who is away from the septic tank and wears particulate mask)</p> <p>This does not fit well with the air purifier mask on the face and must not be worn by the one who is opening the septic tank</p>	<p>Suitable for use as is</p> <p>Study must be undertaken to:</p> <ul style="list-style-type: none"> - Identify the air contaminants present in septic tanks in commercial places and public toilets - Determine the air concentration of the contaminant these septic tanks - Based on the recommendations, further directions can be assessed
KARAM Prokem, Honeywell or BSH Hand gloves (Nitrile) (HS101)	<p>The study has not been able to procure the elbow-length nitrile glove due to non-availability in the market, hence user suitability cannot be determined</p> <p>The identified glove works well for most of the tasks, except it is difficult to find the left and right hand of the pair</p> <p>Right size is important, as the glove might get stuck while clamping suction hose to tank</p> <p>The half hand length is not suitable to avoid complete contact with sludge due to spillage and hence elbow length is recommended</p> <p>Gloves are very important to them, but they are not satisfied</p>	<p>It is recommended that:</p> <ul style="list-style-type: none"> - Ideal gloves be procured - User suitability study is conducted on the lines of mock testing - A time-based user response to safety gear be conducted for a duration of at least 30 day. <p>Further research has to be done to see if elbow-length nitrile gloves are available with 'knurling' feature. If such gloves are not readily available in the market, then design intervention will be required</p>

Table 7.1: Insights and the Way Forward with Safety Gear

Safety Gear	Study Insights	Way Forward
	<p>with the cotton, wool and plastic gloves, that they have used</p> <p>They suggest one pair of gloves each for each desludging operation (at least 3 per day), so that they can be washed and dried. Though they have made this statement in the context of fabric gloves, it holds valid for nitrile gloves, too. This must be considered while deciding the quantities of safety gloves, in the next phase of testing</p>	
Hillson Gumboots PVCSG 011	<p>Even though the gumboots protect against thorns and shrubs, they have limited use as they hinder climbing the vehicle and don't protect against spillage completely. They are not effective for cleaning the septic tank from inside</p> <p>They require open footwear that should be easy to dry, because if sludge enters the shoes, it will cause infection. But detailed observation-based studies must be conducted in order to understand the requirement and efficacy of gumboots</p>	<ul style="list-style-type: none"> - Requires adaptation for issues raised during the study - Thigh protection must be addressed as a separate design intervention exercise - Conduct a time-based user response to safety gear for a duration of at least 30 days. - Based on the responses from this study, further course of action can be charted
Honeywell Four gas monitor – Gasalert Quattro	<p>The workers expressed their curiosity and interest to use the monitor</p> <p>Considering the given interface, the product requires training</p> <p>It must be used with extreme care and caution</p> <p>Given that it is expensive, not many might be able to buy it</p>	<p>Suitable for use as is</p> <p>Training required for use as per Code of Practice, care and maintenance</p> <p>Other measures include:</p> <ol style="list-style-type: none"> 1. Check vent pipe 2. Introduce air blowing method 3. Maintain and check record of cleaning schedule 4. Open the seal and leave it open for about 5–7 minutes, to let off the poisonous gases 5. Inform clients that there is gas in the tank

Table 7.1: Insights and the Way Forward with Safety Gear

Safety Gear	Study Insights	Way Forward
		6. Follow safety gear protocols as per operative guidelines
Caution tape (red and white)	These work well for the process and require no further intervention except in training for use	Training required for use, care and maintenance
Reflective jacket	These work well for the process and require no further intervention except in training for use	Training required for use, care and maintenance
Barrier cone	A barrier cone by itself does not solve the problem of tertiary stakeholders accidentally falling in the septic tank. There may be other ways to create alertness to the situation, through light and sound alternatives	<p>Suitable for use as is</p> <p>Wheel choke to be added to the list of safety gear</p> <p>Research to be conducted on finding alternatives, preferably audio-visual aids, to accompany barrier cones in safety gear</p> <p>Research to be conducted on developing an effective surrounding barricade for the desludging process at night (even though desludging doesn't take place at night, except in some emergencies)</p>
<i>Source: IIHS 2018</i>		

Other safety gear recommended by the study:

Table 7.2: Other Safety Gear Recommended by the Study

Item	Way Forward
Walkie-talkie for communication	In extreme cases, this might be a useful tool. The study suggests that this be included in the sample kit for further testing, to validate its efficacy in desludging process.
Torch	This is very important tool while looking for blockages in the tank. Though it is recommended by law, the safety audit officer has not seen the necessity for it, but the study suggests that this be included in the sample kit for further testing, to validate its efficacy in desludging process.
Safety gear for ears and thighs	<p>Requires design.</p> <p>Ears might be vulnerable while cleaning the septic tank from inside. Further research has to be undertaken to understand the nature of hazard for their health and safety, and design exercises should be conducted for the same.</p> <p>Thighs have not been protected by the recommended safety gear. The study recommends that health and safety hazards be assessed for thighs and design exercises be conducted for protection.</p>

Source: IIHS 2018

7.3.2. Schematic for Design and Implementation of Safety Gear

The features of ideal safety gear have been mapped and workers' (intuitive) responses to them have been recorded and analysed. This table is a chronological schematic representation on the future course of action as recommended by the study. This schematic representation is informed by the study observations, expert opinions, and five Why and other tools. Spread across a period of at least 5 years, the study has tried to ensure that all aspects in addressing hazards will get addressed after the detailed efforts. The schematic table for implementation of future course of action is presented in Table 7.3.

Schematic Components	Imperative	Content	Duration of the Study	Expert Required
Carryout risk assessment through hazard identification and risk assessment (HIRA)	While developing policies around sanitation and FSM, it might be a good idea to elaborate on the human element of desludging workers, the issues they face, and solutions must be articulated to make this occupation a dignified in the eyes of society. The desludging sector must be recognised as a separate industry. Having established that, it will be imperative to carry out risk assessment in this sector	To reduce risks is to identify the hazards and assess their associated risks to determine which are most likely to result in accidents and death. HIRA is a systematic tool for this purpose	1 month	Risk Assessment Auditor IIHS representative
Safety gear sample kit testing	The study has only conducted an intuitive user based response and testing for suitability of sample kit. The recommended safety gear have to be understood for their efficacy to avert hazards in desludging operations, through this testing	The safety gear sample kit, which also includes safety gear (Annexure 4) for getting inside the septic tank, must be procured with the help of a safety auditor. Identify 10 desludging workers for this study, based on the following parameters: - a mix of corporation workers, driver-cum-owners, employee workers - a mix of young and old persons - - enthusiasm and	1 month	Safety Audit Officer Designer IIHS representative

Schematic Components	Imperative	Content	Duration of the Study	Expert Required
		<p>reluctance to wear safety gear</p> <p>They must first be trained for using safety gear, including the sequence of wearing, maintenance, and care, over a period of three days. Parameters for testing can be created in mutual coordination between IIHS, the safety audit officer and designer.</p> <p>Observation and video documentation must be conducted. Based on HIRA, safety audit, and user feedback, further actions can be decided.</p>		
Disposal of safety gear	The study, along with its safety audit consultant, has not attempted to resolve the disposal of safety gear, since most of the safety gear is reusable and can be used for longer durations. Only cartridge and gloves have to be disposed of properly. Usually, in a controlled environment, this safety gear are disposed of in designated places. Desludging workers will have no such designated places.	Study required on how to dispose of safety gear in the context of desludging operations.	1 month	E Waste Consultant Safety Audit Officer IIHS representative
Developing a safety standard manual	Desludging operations are different from other works of sanitation and must be treated as a	The study suggests that a separate safety audit be	1–3 months	Industrial Production Manager/ Industrial Safety Expert

Schematic Components	Imperative	Content	Duration of the Study	Expert Required
	separate entity in the larger realm of sanitation. Findings and studies based on sanitation and sanitation workers have not been found valid for desludging operations. In the same way, existing safety standards for industries and other organised sector have been found inadequate for desludging operations.	conducted to understand the safety hazards in greater detail, and based on the findings, a separate Safety Standard Manual be prepared with the help of experts in the same domain. This can begin in parallel with the above exercise.		Safety Audit Officer IIHS representative
Standard operating procedure		In the context of desludging operations, a detailed standard operating procedure, that includes wearing and removing of safety gear, measuring of poisonous gases, precautions to not inhale poisonous gases, removal of blockages, while averting any kind of hazard, must be articulated, through safety audit process.	1 month	Industrial Production Manager/ Industrial Safety Expert Safety Audit Officer IIHS representative
Establishing Code of Practice	To ensure that the primary stakeholders do not suffer from any OHS hazard, desludging operations must be codified and a Code of Practice be articulated	A Code of Practice will enable the achieving of standards of health and safety required under legislation for primary stakeholders. It also includes going inside the tank and disposing of the gloves and mask. This will happen after the Safety Standard Manual is prepared. The same is an	6–12 months	Industrial Production Manager/ Industrial Safety Expert Safety Audit Officer IIHS representative

Schematic Components	Imperative	Content	Duration of the Study	Expert Required
		exercise at state-level if not national level		
Pilot safety gear testing	Based on observations from HIRA, a Safety Standard Manual, Code of Practice, and a final safety gear kit must be arrived at, and put to test in the field with a larger number, for a period of 3 months. Based on the observations and results, this safety kit could be used for all desludging workers in the state under study.	This 3-month study will include training of all participants, observations, video documentation, user feedback, and analysis, after which the future course of action may be decided.	3 months	Safety Audit Officer IIHS Representative
Design intervention	From the final safety gear testing, it will be very clear as to which items of safety gear require redesign, adaptation, completely new design.	Addressing these in design intervention will require strategising and planning for new products through design, prototyping, and testing on ground. This will also require thinking about how these can be scaled up for mass production, identifying such MSMEs or enterprises who would be willing to produce them. This is a long-term exercise and can take up to 3–5 years.	3–5 years	Product Designer Local Vendors

Schematic Components	Imperative	Content	Duration of the Study	Expert Required
Training	Training for using and maintaining safety gear is very important, as lack of such knowledge might do more harm than good. Safety Standard Manual and Code of Practice must also be taught to them, in order to operate without fear of any hazard.	Based on the safety protocols, training (extensive and intensive) can be provided to primary and secondary stakeholders on the use, maintenance, care and disposal of safety gear. Training has also to be provided for understanding and remembering the Safety Standard Manual and Code of Practice	Ongoing for at least 3 years	Trained NGO professionals
<i>Source: IIHS 2018</i>				

7.4. Other Aspects which Need Further Research

Analysis of the Composition of Sludge

The components of the sludge have to be analysed to understand the health hazards faced by desludging workers. The nature and composition of sludge also varies with establishments. Since primary workers have complained of skin complaints due to contact with sludge, it must be imperative that the composition of sludge across establishments is studied over a period of time, to understand the connection between sludge and its impact on skin and other health-related issues.

The frequency of cleaning septic tanks across various establishments also has to be studied and the findings made a part of the Code of Practice.

Study of Occupational Health Hazards

Toxic gases such as ammonia, carbon monoxide, methane, sulphur dioxide, nitrogen oxide, and others accumulate in the septic tank. They are an immediate cause of death in primary stakeholders. Though this tragedy can be averted with sufficient experience, the possibility of death due to asphyxia cannot be negated or eliminated. This is the biggest health hazard for primary stakeholders and must be addressed on the lines of immediate treatment and further treatment in hospital. Of course, safety gear prescribed by the law recommend airline breathing apparatus while getting in the septic tank. But, based on our experiences of workers' problems and issues, they might not be enthused by the idea of such apparatus.

The issue of addressing health standards while workers are inside the tank has to be addressed along with safety standards. The workers wash their hands and feet with soap and water every time they get in contact with sludge, since they are aware of health risks associated with their occupation. While it has been understood in our discussion with experts that disease-inducing bacteria and microbes don't survive in an acidic environment beyond a day, the possibility of communicable diseases like typhoid,

cholera, diarrhoea, and malaria, cannot be ruled out, because the septic tank contains a lot of chemical waste. Most of the experts have mentioned this possibility but almost no instances of this were found during the study.

The nature and extent of this hazard has to be understood through dedicated scientific studies in the context of desludging operations. The study suggests that a separate and specific study on occupational health hazards be conducted to understand the possibilities of contracting diseases through contact with fecal sludge. This must take into account the possibility of chronic illness due to contact with sludge.

Based on the findings of the study, a proper occupational health standard of practice can be created for desludging workers and drivers and a future plan of action can be decided upon.

Socio-ethnographic Research on Desludging Workers

Desludging workers operate in different conditions than sanitation workers. Most of them are private operators and engage with their clients on a one-to-one basis, through the acts of marketing, cleaning, bargaining, etc. This engagement makes them very different from other sanitation workers. This element must be considered and a separate space for them in policy making may be allocated, as it has its own dynamics and own set of rules, management and operations. A detailed socio-ethnographic research may be conducted on them to understand their thought-processes, business practices, social and caste identity. Based on the study, a separate set of parameters and tangents may be developed. With the emergence of unique parameters suited and catered to them, policy makers might be able to find valid and justifiable answers to the solutions they face.

Psychological Well-being

Stakeholders need to be in a sound state of health and mind and should be aware of various kinds of risk that are associated with their occupation. Their pride in their profession notwithstanding, if they are physically ill or mentally upset, for any reason, then they must not continue with their work for that day. In reality owners do ensure that the mental and physical well-being of the driver and worker is taken care of. For instance, if there is an accident or mishap, they ensure that the worker or driver is taken to the hospital immediately, and all medical expenses are paid for. They also allow them to rest for the required time.

However, the owner-cum-drivers rely on the daily work order and earn on a daily basis. They and their workers keep on working relentlessly and might not have time or take time off to cure any physical injuries or take care of their psychological health. Ensuring their health and well-being must be one of the prime concerns. There could be a centre with a group of doctors and counsellors to take care of psychological well-being.

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ANNEXURES

Annexure 1: List of Experts

Name	Domain
S Mohd Sherrif, S Damodaran	NGO
Ms Sudha	Administration
Judge Pramod Goel	Law
Ravichandran Bathran	Social Activist
Dr S Vasuki	Health
Dr Dhanapaul	Health
Dr R Saundaraj	Health
Dr Shivaramakrishna	Health
Dr T A Sanjeevi Perumal	Health
Dr Alli	Health
S Sunil Kumar, Safety Management	Safety
S Sundaramoorthy	Safety
Ms Angel Janet	Safety
Mr Rajashekharan	Safety

Annexure 2: Process Documentation

	Steps	Detailed description	Time taken
ZONE 1- Reaching the Site	Step 1 Primary stakeholders leave home for work	<p>The two primary stake holders – the driver and the worker, also called service providers, leave their homes at around 7-8 am for work. They are usually seen wearing a lungi and shirt or t-shirt. Elderly men usually wear half-sleeved (brown colour) shirts, while younger workers are seen in t-shirts with collars or round necks. The younger generation might prefer jeans, trousers and new shirts.</p> <ul style="list-style-type: none"> • If it is the owner cum driver, he gets into the vehicle along with his worker and drives from home to the parking station. • If the driver and owner are employees of a septic tank unit, they reach office in the morning and wait for the client's call • If the order has been placed the day before, then they leave for the site from office immediately • The corporation driver starts at 6 am from home in the vehicle, picks up the worker from any location near his home. They perform the desludging operations at public toilets between 6 and 9 am. They begin their work again between 11 am and 2 pm. The reason for the two-hour gap is that there is traffic on the roads because of schools and office rush hour. 	NA
	Step 2 Arriving at Stand	A stand is the place where yellow-coloured sludge suction vehicles are parked. Hand-painted information such as the name of the septic tank contractor and mobile phone numbers are painted legibly using big bold font on the body. The primary service provider (owner-cum-driver and worker) arrive at the stand between 8-9 am and wait for the client's call. One parking stand is under the flyover, while the other parking stand is on a certain service road. These places are also their offices.	NA
	Step 3 Preparing vehicle and waiting for the phone call from a client	The owner-cum-driver, after reaching the parking stand, washes his vehicle or performs any other act required for the maintenance of the vehicle. While the standard timings to begin work are between 8-9 am, if they receive a call in the night, they do the task, and demand more money for their services.	10 - 15 minutes
	Step 4 Navigating to job site	Once the work order has been confirmed (either on the phone, or if the client comes to the parking stand), the driver asks for the address and directions, and proceeds with his worker towards the location. He observes all required traffic rules. They do not consume alcohol while on duty which the traffic police might check them for on road.	15 - 30 minutes

Z o n e 2 – O n s i t e	Step 5 Assess site condition	<p>Once they reach the area, they park the vehicle in a safe zone (to avoid traffic jams or to safeguard the vehicle) and reach the site. Both the driver and the worker look for:</p> <ul style="list-style-type: none"> - the nearest distance between the vehicle and the septic tank, to assess how many hoses will be required to cover the distance - the nature of the covering of the septic tank, what tools will be required to break the covering - the size of the septic tank, including its depth, length, and width <p>Owner-cum-driver: If it is a first time client, they seek information on the last time the tank was cleaned. Based on the amount of time required to clean the tank and distance between the vehicle and the tank, they quote the amount. After bargaining and mutual consent, the work can begin. If it is an old client, then no questions are asked about the septic tank. They talk about remuneration and begin the work.</p> <p>Employee driver and worker: Since all discussions on money have been concluded between the owner and the client already, they assess the site and begin with the next steps of the process.</p>	3 - 5 minutes
	Step 6 Interim parking/camping at nearest access point	The service provider (driver) gets into the vehicle and brings the vehicle as near as possible to the site, while the worker helps him park the vehicle. The driver gets down from the vehicle after having parked at the correct spot.	3 - 5 minutes
	Step 7 Take out tools and equipment	<p>Septic tanks are either sealed or have openable lid, and the tools vary accordingly. In case of a sealed septic tank, a crowbar is used to break open the lid.</p> <p>In the case of corporation vehicles, the driver does not participate in any step, till described otherwise. The worker unties the rope that binds the hose to the vehicle with his hands. Since they empty public and community toilets only, they don't use any other tool. He lifts the slab by hand, as it is closed temporarily only. (These toilets are cleaned at an interval of 7-15 days). However these openings are at strategic locations and don't invite public engagement.</p> <p>In the case of owner-cum-driver, employee driver and worker, they take out the crowbar with their bare hands and reach the septic tank to break open the cement covering on the slab.</p>	5- 7 minutes

	Step 8 Break open septic tank seal using tools	Opening the seal of the septic tank is one of the first tasks. The worker breaks the cement cover from the edges of the slab with the help of a crowbar. He then removes the slurry on the side to make way for opening the septic tank.	2 - 3 minutes
	Step 9 Open septic tank lid	In both cases, they begin to break the cement covering on the slab with the help of crowbar and hammer (with their hands) from one side, and continue to do so, till the entire rectangle/ square slab, is broken off. Feet are in a lunge-like position to get better grip on the ground. This step is not valid for corporation workers, as the slab is not fixed to the ground. Opening a septic tank, sealed or otherwise, is always done with caution. If the septic tank has a movable lid, it is pushed aside with bare hands. If it is sealed, it is opened with a crow bar. As the septic tanks are not of a standard design, the size of the lid varies. Here, the workers rely on experience to judge and gauge the structural quality and strength of the septic tank for further action.	5 - 15 minutes
	Step 10 Visually assess contents of septic tank	After opening the lid of the septic tank, the worker takes a closer look into the tank to understand the nature of the sludge. They bend down from their waist to get closer to the tank, to determine the viscosity of the sludge. If the sludge is thick, the process gets a bit vigorous, as indicated in steps 17 A, B and C. They also gauge the number of trips required to the decanting station based on the volume of the tank.	1 - 2 minutes

	<p>Step 11 Assess for presence of poisonous gases</p>	<p>Once the slab is open and put aside, they check if poisonous gases are present in the tank. The availability and location of the vent hose is checked in the previous steps already. Cockroaches in the tank indicate that there is some oxygen in the tank, and less concentration of poisonous gases. If there are no cockroaches, then it is a sign of concern. They adopt various indigenous methods including using fire – either through a matchstick or a lamp in the bucket, or a candle or burning piece of newspaper. If the fire extinguishes, it indicates the deficiency of oxygen. If the fire burns brightly, there is the presence of methane and other poisonous gases in the tank. They also know of the presence of poisonous gases, if they suffer from eye burning, irritation, watering and breathlessness.</p>	<p>2 - 15 minutes</p>
	<p>Step 12 Keep the septic tank lid open for gases to escape</p>	<p>Even if there are no poisonous gases in the tank, they leave the tank open for of 5-7 minutes while they prepare to empty the septic tank. This allows for gases to escape from the tank. If there is an indication of poisonous gases, they wait for a period of 15-30 minutes. In this interval, they might either go for a tea break or 'canvas' for their service, by throwing their visiting cards in the compound of every household in the vicinity.</p>	<p>5 - 30 minutes</p>
	<p>Step 13 Prepare for emptying of the septic tank</p>	<p>In the duration of those 5-7 minutes, they prepare for the next stage of emptying the septic tank. The worker unties the rope that binds hoses with the vehicle with his hands. He also connects the hose to the foot valve of the vehicle. He arranges for additional intermediate hoses to be joined to reach to the septic tank. This requires an intense coordination between hands and legs, though the full body is engaged. He might be assisted by the driver, in case of difficult navigation. The corporation driver doesn't assist the worker in this activity.</p>	<p>1 minute</p>
	<p>Step 14 Bring the hose to the septic tank</p>	<p>The worker brings the hose to the edge of the septic tank with his hands. In case of a shorter distance between the septic tank and vehicle, only one hose is required, while in case of longer distances, more than one hose needs to be connected and fixed. In the case of corporation vehicles, the worker is not assisted by the driver. In other cases, the driver assists the worker throughout the whole process.</p>	<p>1 - 3 minutes</p>
	<p>Step 15 Fix intermediate hose connections</p>	<p>The intermediate hoses are then fixed with the help of a joining clip with hands. The worker also bends himself or sits on the ground in a squatting position to perform this task. He might be assisted by the driver in certain difficult cases.</p>	<p>2 - 3 minutes</p>
	<p>Step 16 Remove cap, attach and clamp sludge suction hose to valve in vehicle</p>	<p>The last hose is connected to the vehicle. This is done by one person by placing the hose between the thigh for the sake of better grip, and is connected to the foot valve. The worker performs these tasks with his hands. He bends himself from waist down, sits on the ground in a squatting position and stands in order to complete the process. He might be assisted by the driver in certain difficult places, in both cases.</p>	<p>1 - 3 minutes</p>

Step 17 Liquidify sludge, if it is thick (in certain households, where septic tanks have not been cleaned for more than two years), through a mix of various techniques	If the sludge is thick because the tank has not been cleaned for a very long time, then the following techniques are used: air blowing with machine, mixing water with thick sludge, and mixing sludge with a stick.	5 - 15 minutes
Step 17 A Blow air by reversing the motor to mix sludge (in certain cases only)	Sometimes, this process is also required to remove the sludge. In this case, the driver starts the vehicle engine and reverses the motor after sitting in the vehicle. Both of them coordinate by talking loudly if they can't see each other. If they are able to see each other, they may communicate in sign language with their hands. This requires presence of mind and immediate reaction, and active coordination of all body parts. This process resolves the problem of thick sludge in up to 90% of cases by liquidifying it.	5 - 15 minutes
Step 17 B Use water to liquidify the sludge	In case of public places such as colleges, schools or restaurants (a mix of grime and foreign objects), water is required to be put in the tank to liquidify. That helps to ease the suction process.	5 - 15 minutes
Step 17 C Use a flat-bottomed tool or stick to mix sludge and water	The worker uses a stick or a flat-bottomed tool to scrape and mix sludge contents with water. This requires a mix of observation, technical expertise and the efficient use of hands.	5 - 15 minutes
Step 18 Driver opens the inlet valve	While the worker sits on the edge of the tank, performing either of the above two mentioned tasks, the driver reaches the vehicle and opens the inlet valve. This is true for both cases. In the case of corporation vehicle, the worker rarely encounters the above two steps, as the septic tank is emptied every 7-15 days.	30 seconds
Step 19 Driver switches on the pump for suction	After the inlet valve is opened, the driver switches on the motor for suction, while the worker waits for the process to begin at the edge of the tank. In case of corporation vehicle as well, the driver switches on the motor switch (which is at the back of the driver's seat) with the use of his hands.	30 seconds

Step 20 Lower hose to increase efficiency of suction	One of the most important tasks in the desludging operation is lowering the hose inside the septic tank to pull out sludge. It increases the efficiency of the suction. The worker puts the hose bit by bit in the sludge. There are two reasons for this – to pull in the sludge without encountering any blockage, and to ensure that only the bottom part of the hose touches the sludge, while the large part remains clean. As the amount of sludge decreases, the hose is put further down, and the whole process is repeated. If any foreign objects block the entrance of the hose, the hose is taken out to the edge of the septic tank, the foreign objects are pulled out, and the hose is put back into the tank. While inserting the hose in the sludge it is difficult to manoeuvre, the worker is able to decipher this through the pressure that he feels on his hands, while dipping the hose. The driver might assist the worker in pulling the hose, or might pull the foreign object out, after the worker brings the hose to the edge of the tank. Both of them are seated in the squatting position, and actively use their hands to perform this task. The corporation driver does not participate in this act. Through this exercise, the entire tank is emptied.	10 - 15 minutes
Step 21 A Identify if sludge is very thick at bottom	The worker checks the septic tank again, to see if it is cleaned properly. Based on his experience and technical skills, he gauges if the following steps are required. If he notices any more sludge at the bottom, and realises that it is thick, the worker asks the client to open the water tap again.	30 seconds-1 minute
Step 21 B Pour more water	The worker pours more water through the hose on the floor and creates a puddle. This scenario is usually true for a household whose septic tank has not been emptied for a very long period of time.	3 - 10 minutes
Step 22 Use of a flat-bottomed tool or stick to mix sludge and water	The worker uses a stick or a T-shaped tool to scrape and mix contents in the water, and empties the sludge into the vehicle. This step is a mix of observation, technical expertise and the efficient use of hands. The driver helps him with holding the hose, if required. Sludge gets suctioned out simultaneously.	2 minutes coinciding with the above
Step 23 Look at the volume indicator on the vehicle to see if the suction tank is full	If the sludge volume indicator on the top of the vehicle indicates that the vehicle is full, the driver stops the motor. This step is a mix of coordination between the driver and the worker. The driver calls out to the worker and communicates the same to the worker. Both of them stop the activity. Sometimes, they can understand that the suction tank is full just by the sound of the motor. This skill comes with experience.	30 seconds
Step 24 Decide to finish cleaning in the second round	Since the vehicle tank is full, the driver and the worker make a joint decision to go to the decanting station to empty the vehicle tank and come back to finish the work in the second round. But they don't have to take all hoses along, because they will need them for the second phase.	NA
Step 25A Leave all hoses on the ground	The worker does not disconnect the intermediate hoses. He leaves them on the ground.	NA

Step 25B Close valve lever	The driver closes the valve lever, if the worker is engaged with disconnecting the hose. In the case of corporation vehicle, the worker performs this task.	30 seconds
Step 25C Disconnect hose from the foot valve	The worker disconnects the hose on the vehicle from the foot valve with his hands.	1 minute
Step 25D Clean self	The worker then washes his hands and feet with water. Sometimes they use soap. If the driver has also assisted him, he washes his hands and feet too.	3 - 5 minutes
Step 25 E Navigate to nearest decanting station	The driver and the worker sit in the vehicle and the driver drives the vehicle to the nearest decanting station. The process from here is described from Sr No 36-45.	30 - 45 minutes
Step 25F Come back to the site in the vehicle	The driver and the worker come to the site again to finish the incomplete task of emptying the septic tank.	same as above
Step 25G Bring the hose to dip into tank	The worker brings the hose to the edge of the septic tank with his hands.	30 seconds
Step 26A Remove cap, attaching and clamping sludge suction hose to valve in vehicle	The last hose is connected to the vehicle. This is done by one person by placing the hose between the thighs for the sake of better grip, and is connected to the foot valve.	1 -3 minutes
Step 26B Driver switches on the motor for suction	After the inlet valve is opened, the driver switches on the motor for suction, while the worker waits for the process to begin at the edge of the tank.	30 seconds
Step 26C Lower hose to increase efficiency of suction	One of the most important tasks in the desludging operation is to navigate the hose inside the septic tank to pull out sludge. It increases the efficiency of the suction. The worker puts the hose bit by bit into the sludge.	10 - 12 minutes

Step 26D Clean the walls of the septic tank by spraying water on walls and floors of septic tank	After this, the worker sprays water on the walls and floor of the septic tank to remove the remaining sludge. This sludge is then sucked out with active use of hands while seated in the squatting position. The driver may or may not be assisting the worker in this step. The corporation drivers do not undertake this task.	7 - 12 minutes
Step 27 The desludging work is over	The septic tank is now empty. At this point, the client inspects if the job is done. The conversation about getting inside the tank begins. The process of getting inside the septic tank is elaborated in steps 47- 53.	30 seconds
Step 28 Close the septic tank	The worker closes the lid. In some cases the worker also does the job of the mason, to seal the lid of the septic tank with cement and sand.	3 - 15 minutes
Step 29 Closes Valve lever	The driver closes the valve lever if the worker is engaged with disconnecting the hose.	30 seconds
Step 30 Disconnect the hose from the foot valve	The worker disconnects the hose on the vehicle from the foot valve with his hands.	1 minute
Step 31 Close the foot valve cap	After this, the worker closes the hose and puts the cap of the vehicle's inlet back with his hands.	30 seconds
Step 32 Disconnect intermediate connections	The worker, sometimes with the assistance of the driver, disconnects intermediate connections and dismantles all hoses. This action is a combination of the movement of hands and legs, and technical skills. The corporation driver doesn't assist in this process.	2 - 4 minutes
Step 33 Clean dipped hose	The worker cleans the dipped hose with water in a bucket (always there in the vehicle). Then the inside of the hose is rinsed with water in the bucket.	1 - 2 minutes
Step 34 Clean outside of dipped hose by pouring water	First, water is thrown on the outside part of the hose, through the bucket. If the hose is still dirty, then the worker cleans it with his hands.	1 - 2 minutes
Step 35 Clean inside of hose by pouring water and lifting hose to clear contents	After the water is poured inside the hose, the hose is raised vertically to allow the water to rinse the inside of the hose. The sludge water comes out of from the other side of the hose, ensuring that the inside of the hose is clean.	1 - 2 minutes

	Step 36 Load the hose back on vehicle	The intermediate hoses are then dismantled and tied back to the vehicle with the help of the rope. The corporation driver does not help the worker in this step, but in other cases, the driver assists the worker. A seamless coordination of motor skills ensures swift movement and completion of the step.	1 - 2 minutes
	Step 37 Clean self	The worker then washes his hands and feet with water. Sometimes they use soap. If the driver has also assisted him, he washes his hands and feet too.	3 - 5 minutes
	Step 38 Driver negotiates/ receives payment	Driver negotiates in case of extra trips made during desludging and decanting cycle, or in case of more solid sludge material as it consumes more diesel.	3 - 15 minutes
ZONE 4- At Decanting station	Step 39 Navigate to nearest decanting station	The driver and the worker sit in the vehicle and the driver drives the vehicle to the nearest decanting station (songs play in the vehicle). It is relieving that the arduous task is over.	15 - 20 minutes
	Step 40 Park near the decanting well	At the decanting station, the driver parks his vehicle closest to the decanting well. This requires very strong driving and parking skills on the part of the driver. The worker helps him find the exact spot by giving him directions either by hand or by talking. At times, there might be just one vehicle emptying in the decanting station, at other times; there might be a maximum of 5 vehicles doing the same activity. This is valid for one decanting station. Other three decanting stations have narrow passages and allow for only one vehicle to empty into the decanting well. In the context of one decanting station, the parking skills of the driver are very crucial to ensure that no mishap occurs with other vehicles.	2 - 5 minutes
	Step 41 Remove cap, connect single hose to outlet valve	The worker connects the hose to the outlet valve. Sometimes, he unties the rope and uses his own hose from the vehicle to pour the sludge in the decanting well. If the vehicle is a frequent visitor to the decanting station (like the vehicles engaged for desludging the apartment waste), they leave one hose on the ground. They also have a specific parking spot in the decanting station. The peculiarity lies in the fact that they created a small cavity on the ground in which the back part of the vehicle can be parked. The reason for building this cavity is to create a recline that allows for the sludge to flow without any great effort.	1 - 3 minutes
	Step 42 Put the other end into decanting well	As explained, the worker puts the rear end of the hose into the decanting well. The worker might stand on the walls on the well, just for the sake of fun. In the night time activity, it was noticed that one thin log of wood was put on the ground to give support to the hose.	45 seconds
	Step 43 Start the motor to decant	The driver then starts the motor of his vehicle to begin the emptying of sludge into the decanting well.	30 seconds

Step 44 Open the valve to empty the contents	Once the vehicle is parked, the worker opens the outlet valve cap with his hands. Some water pours out of the outlet. His feet are naked and without any footwear. Sometimes the water might spill on his feet and he jumps backwards.	30 seconds
Step 45 Pay the charges for decanting	The charges for decanting are Rs 30 per trip. If the vehicle is not a regular visitor, they pay per trip. The site supervisor monitors every vehicle and gives them a receipt. Other vehicles, who are regular and visit every day, may settle the bills and pay once in 2-15 days. The driver takes care of these transactions.	Simultaneously happening with step 43
Step 46 Wait to empty the vehicle and monitor the flow	In this period of 3- 5 minutes, when the vehicle is getting emptied, the worker and driver chat with other colleagues, or drink water, or talk on the phone with friends or family members, or just listen to songs on their mobile phones. There are times when workers and drivers also relax and have lunch at the decanting station.	3 - 4 minutes
Step 47 Disconnect the hose	Once the vehicle is emptied, the worker disconnects the hose from the valve with his hands.	45 seconds
Step 48 Hose is put back on vehicle	If the hose is meant to be kept on the ground, that act is performed. If the hose is meant to be tied to the vehicle with the thread, then the worker performs that task with his hands. If the work is not over, they go to the site once again, to complete the process. They pay for two trips, accordingly.	2 - 3 minutes
Step 49 Clean the vehicle once in a month	Once every month, the worker and driver clean the inside of the vehicle tank. They also paint the inside of the vehicle with bright colours once a year.	
Step 50 If any of the following conditions are met, then the need for getting inside the septic tank arises	Sometimes there is a need to get inside the septic tank for the following reasons: 1) If there is block in the inlet hose of the loo to the septic tank 2) In case of masonry work 3) If the client insists on desilting and cleaning the ground and walls of septic tank 4) In case of the employee driver and worker, the worker offers to clean the inside of the septic tank to make more money The corporation workers never enter the inside of the septic tank, as it is against the law. In case of the employee driver and worker, the client discusses the same possibility with the owner. If the owner wishes to respect the law, he refuses to do so. In the other category, the driver asks for more money for getting inside the tank. After bargaining and discussing, the process of cleaning the inside of the septic tank begins.	

ZO NE 3- Insi de sep tic tan k	Step 51 Put ladder in the septic tank	The driver borrows ladder from the client and puts it in the tank. They don't keep the ladder in the vehicle. It is usually a wooden ladder. The ladder might or might not be touching the ground of the septic tank. He might do that with his clothes on or might remove his shirt and trousers. He might go inside with his underpants on. It is heard that they apply a thick coat of coconut oil before going inside a septic tank, so that the sludge doesn't touch the body. All stakeholders have complained that various foreign objects in the septic tank are a major cause of concern, especially sanitary napkins. The others are – bottles, glass, pens, pencils, undergarments, etc.	30 seconds
	Step 52 Descend into the tank	Without changing out of his existing attire used for other processes, the worker enters into the septic tank. After entering, a torch is passed down. In the case of public toilets for schools/college/ women's hostels, before the worker climbs down the ladder, lots of water is poured through the hose to liquidify the sludge. He may go down up to knee deep in the sludge, manoeuvre through the thick sludge, remove the blockages, and navigate the hose to suck out the sludge through an effective coordination of the entire body, with hands and legs at the core of this movement. In the case of households, the septic tank is already empty and the ladder touches the ground. The worker gets into the tank to identify the future course of action.	45 seconds - 2 minutes
	Step 53 Clean the inside of the septic tank	Most work is done with bare hands. During this time, there is a lot of coordination and communication between the worker inside the septic tank and the driver outside the septic tank. In manoeuvring through the thick sludge, the worker identifies the blockages and removes them through various kinds of indigenous methods – using a stick or a piece of cloth to pull the block. In the case of households, it might be a single object. Or in the case of public toilets for schools/college/women's hostels, it may be that the tank may be full of foreign objects– pens, pencils, glass and plastic bottles, cloth pieces, sanitary napkins, undergarments, razor, soaps. The worker keeps clearing the blockages and removing the foreign objects till the vehicle is full and the indicator gives an alert. The driver might assist him in bringing the foreign objects out on the ground.	20 - 40 minutes
	Step 54 Climbs up the ladder	In case of the household tank, the worker washes himself in the septic tank first, before coming out of the tank. In the case of public places, once the tank is full, there are chances that the process of getting inside the septic tank will be repeated. In this case, the worker climbs back on the ladder and comes out of the tank. The ladder is pulled out, cleaned and kept aside.	45 seconds - 2 minutes
	Step 55 Seals the septic tank	In some cases the worker also does the job of the mason, to seal the lid of the septic tank.	3 - 15 minutes

	Step 56 Cleans himself	In case of the household tank, the worker comes out of the tank, demands a brand new soap and water from the client. They take a full bath, sometimes in the bathroom or sometimes in the open. In case of a public place, the worker cleans his feet and hands only, as he has to go back inside the tank in the next round. After the tank is finally cleaned, he has a shower with soap and water.	5 - 10 minutes
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Annexure 3: Safety Gear Identification.

This annexure is a compilation of various health and safety hazards by various touch points and safety gear identified from various perspectives. The safety gear identified by the law has been verified and understood from the perspective of the process and then verified by the safety expert.

Process and Step Numbers (as in Annexure 2)	Touch Points	Safety Hazards	Health Hazards	Safety Gear as Indicated by the Law	Safety Gear Features as Understood in the Process	Safety Expert Recommendations
Zone 2 Opening the septic tank (8, 9, 10, 11, 12)	Feet, knee, thigh	Bruises, wounds or physical injuries while: - Assessing the conditions (thorns, bushes and stones) - Opening the slab - Removing the lid with tools and equipment	These injuries might be minor, but, if untreated, can lead to bigger problems like sepsis and other health related issues.	Gumboots	<ol style="list-style-type: none"> 1. Cover legs (toe to knee) 1. Snug fit 2. Weather proof 3. Slip resistant 4. Light weight 5. Easy to wear and remove 6. Provide cushioning and arch support 7. Have puncture resistant sole 8. Should be comfortable for climbing ladder 9. Should be comfortable for walking 10. Should cover legs (from hip to knee) to prevent pipes direct contact with body 	Gumboots as per IS 15298 (Part 2): 2011 is suggested. But it will restrict kneeling while working. Wader shoes can be considered as a possibility.

Process and Step Numbers (as in Annexure 2)	Touch Points	Safety Hazards	Health Hazards	Safety Gear as Indicated by the Law	Safety Gear Features as Understood in the Process	Safety Expert Recommendations	
	Hands, legs, dehydration and nausea in the body			First Aid kit		Standard first aid box contents can be kept, but drugs/medicines should not be kept, as it may induce drowsiness. Medicines, if any, must be recommended by the medical expert, after analysing the desludging operations.	
	Worker himself			Reflective jacket		The desludging worker must be identified from a distance, so that the passers-by are aware of the desludging activity in the vicinity	Net type red coloured Hi Viz wear to be used.
				Barrier caution tape		1. Barricade the area 2. Place a safety grill on the lid 3. Must be accompanied with a sound and light indicator 4. Must be accompanied with a work-in-progress indicator	White and red tape can be placed around the septic tank during desludging and when the tank is kept open.

Process and Step Numbers (as in Annexure 2)	Touch Points	Safety Hazards	Health Hazards	Safety Gear as Indicated by the Law	Safety Gear Features as Understood in the Process	Safety Expert Recommendations
				Barrier cone	<ol style="list-style-type: none"> 1. Barricade the area 2. Place a safety grill on the lid 3. Must be accompanied with a sound and light indicator 4. Must be accompanied with a Work-in-progress indicator 	Barrier cone with plastic chain (white and red) can be used. Cone is better than tape as the tape cannot be reused more than twice or thrice. But cone needs a storage space in the driver's cabin in the vehicle. I recommend cone instead of tape. Wheel choke is required.

Process and Step Numbers (as in Annexure 2)	Touch Points	Safety Hazards	Health Hazards	Safety Gear as Indicated by the Law	Safety Gear Features as Understood in the Process	Safety Expert Recommendations
	Nose, mouth	Accidental falling in septic tank Physical injury due to foreign objects in the tank (blades, glass bottles, pens, pencils, etc) Death due to asphyxiation because of poisonous gases Unconsciousness	Inhalation of large quantities of poisonous gases (hydrogen sulphide, ammonia, methane, carbon monoxide) leading to asphyxiation related deaths Prolonged and passive breathing of poisonous gases can cause breathlessness, asthma, lung and respiratory diseases.	Breath mask	Prevent poisonous gases from entering nose, mouth and lungs Protect from sludge spillage entering the mouth Protect from dust Fit snugly	Breath mask with N 99 or N 100 efficiency can be used. This N type respirator will work for all situations. Masks must be used within 5 years from the date of manufacturing if it is kept unopened inside the factory packing. If opened it can be used until the colour changes due to dust and contaminants or if the user feels it is tough to breathe.
	Nose, mouth			Face mask + air purifier gas mask/chin cortege	Prevent poisonous gases from entering nose, mouth and lungs	Half-face mask with suitable NIOSH-certified acid vapour cartridge to be used while opening the lid. The main body can be used for a lifetime, but the canister must be changed as soon as the indicator goes black.

Process and Step Numbers (as in Annexure 2)	Touch Points	Safety Hazards	Health Hazards	Safety Gear as Indicated by the Law	Safety Gear Features as Understood in the Process	Safety Expert Recommendations
	Nose, mouth			Gas monitor (4 gases)	Mechanism required for identifying poisonous gases from a distance	Multi gas meter to be used to check the presence of O ₂ , H ₂ S, CO & CH ₄ . The practice of igniting paper and dropping it inside has to be stopped as the methane will explode. The practical difficulty is who is going to do the atmospheric testing and how it will be issued to each vehicle as it costs near about Rs 50,000 per piece.
	Eyes			Safety goggles	<ol style="list-style-type: none"> 1. Not hinder vision 2. Not hamper communication 3. Not fog up 4. Not slip out off head when bending down 5. Prevent sweat from trickling into the eye 6. Protect from dust particles 7. Protect from gas irritation 	Chemical splash goggles with side protection to be provided. Goggles with rear band can be provided rather than with goggles with temple as the latter may fall down into the pit/tank.

Process and Step Numbers (as in Annexure 2)	Touch Points	Safety Hazards	Health Hazards	Safety Gear as Indicated by the Law	Safety Gear Features as Understood in the Process	Safety Expert Recommendations
Zone 2 Inlet valve related (16, 25 C, 26 A, 30, 31, 32, 33, 34, 35, 36, 41, 42, 44, 47, 48)	Hands, feet, knees, thighs	Bruises, wounds or physical injuries while working with pipes and inlet valve with tools and equipment, or due to foreign objects on the ground (blades, stones, thorns, shrubs, etc)	Skin-related issues because of contact with sludge due to spillage if proper personal hygiene is not maintained. Wounds and bruises, if left untreated, can cause sepsis, infection and other diseases.	Gloves (apart from all mentioned above)	Have good grip to move heavy cement slab Have physical protection for hands from rough surface Protect hands from touching sludge Provide good fit Provide tactile feedback while holding tools and suction hoses Be water- and spill-proof Be tear-resistant Should not get caught in between tools Be easy to wash and quick to dry	Elbow-length nitrile gloves with grip on palm to be used. Should be reusable. Can be washed.
	Hands			Barrier cream		Kerodex hand protection cream is widely used in industries while handling hazardous substances. The same can be used here.

Process and Step Numbers (as in Annexure 2)	Touch Points	Safety Hazards	Health Hazards	Safety Gear as Indicated by the Law	Safety Gear Features as Understood in the Process	Safety Expert Recommendations
Zone 2 Pipe related (16, 25 C, 26 A, 30, 31, 32, 33, 34, 35, 36, 41, 42, 44, 47, 48)	Hands, feet, knees, thighs	Bruises, wounds or physical injuries while working with pipes and inlet valve with tools and equipment, or due to foreign objects on the ground (blades, stones, thorns, shrubs, etc)	Skin related issues due to contact with sludge due to spillage and other factors	SAME AS ABOVE		
Zone 4 Inside the septic tank (50, 51, 52, 53, 54, 55, 56)	Nose, mouth	Accidental falling in septic tank Physical injury due to foreign objects in the tank (blades, glass bottles, pens, pencils, etc) Death due to asphyxiation because of poisonous gases Unconsciousness	Skin related issues, including itching and rashes if proper personal hygiene is not maintained	Airline breathing apparatus		To be used while getting inside the septic tank. It is costly, therefore cannot be purchased by individual worker. It also requires extensive training. So it may not be used.
	Nose, mouth			Breathing Apparatus		To be used while getting inside the septic tank. The worker has to carry the oxygen cylinder on his back and therefore not feasible.
	Full body, except face			Full body wader suit		The worker must wear nitrile coated full body coverall while entering the septic tank

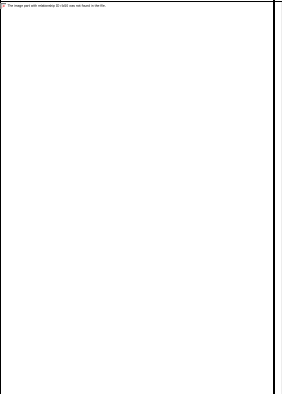
Process and Step Numbers (as in Annexure 2)	Touch Points	Safety Hazards	Health Hazards	Safety Gear as Indicated by the Law	Safety Gear Features as Understood in the Process	Safety Expert Recommendations
	Full body, except face			Nylon rope ladder 5 meters		To be used while getting inside the septic tank. Both nylon and polypropylene rope can be used
	Full body, except face			Nylon safety belt		To be used while getting inside the septic tank. Same as safety belt, safety body harness. The safety body harness must be of IS 3521: 1999 and KARAM brand only, and only that must be bought.
	Full body, except face			Safety belt		To be used while getting inside the septic tank. Same as nylon safety belt, safety body harness. The safety body harness must be of IS 3521: 1999 and KARAM brand only, and only that must be bought.

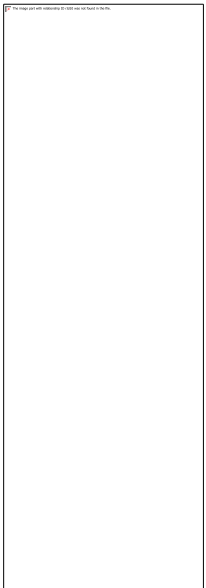
Process and Step Numbers (as in Annexure 2)	Touch Points	Safety Hazards	Health Hazards	Safety Gear as Indicated by the Law	Safety Gear Features as Understood in the Process	Safety Expert Recommendations
	Full body, except face			Safety body harness		To be used while getting inside the septic tank. Same as nylon safety belt and safety harness. The safety body harness must be of IS 3521: 1999 and KARAM brand only, and only that must be bought.
			Consumption of alcohol and tobacco to counter work related stress. They don't consume alcohol while on work; it is only after work that they indulge in alcohol. They consume tobacco while on work.	NA		

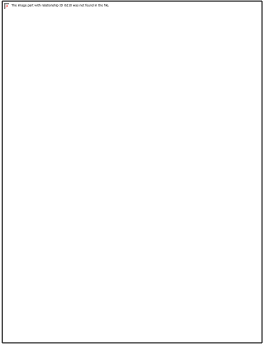
Process and Step Numbers (as in Annexure 2)	Touch Points	Safety Hazards	Health Hazards	Safety Gear as Indicated by the Law	Safety Gear Features as Understood in the Process	Safety Expert Recommendations
				<p>Exclusive protection for ears and thighs are not mentioned in the law, but might be important for desludging operations. This aspect needs further delving into.</p>		
				<p>While safety expert has not included safety torch as a part of the sample kit, it might be important in the context of getting inside the septic tank.</p>		


Annexure 04: Protection Recommendation for Safety Gear


This annexure presents the sample safety kit that has been purchased and tested in the field to understand the emotive, ergonomic and functional response of stakeholders. We also record the way forward for usage in safety gear based on field testing, expert opinions, stakeholders' views and the study observations.


Tested Safety Gear	Features	Issues	Primary Stakeholders' Views from Interviews and Testing	When to Wear and Remove as per SOPs (step numbers in process_Annexure 2)	Study Insights	Way Forward for Safety Gear
<p>Reflective Jacket</p> 	<p>Offers a distinct visual identity and alerts passers by</p>	<p>Sizes may have to be adapted to fit individual body size</p>	<p>Corporation workers have complained of being treated improperly by tea vendors, because of stigma associated with orange colour; as people know that this is for cleaning staff. They have to wait for longer durations to get tea, because they used to wear the jacket. Private workers say that it is more useful for work at night, because of light emitting quality.</p>	<p>3. Preparing vehicle and waiting for the phone call from a client To be removed only after day is over</p>	<p>The reflective jacket offers safety by communicating that work is in progress.</p>	<p>Suitable for use as is Training required for use, care and maintenance</p>


Tested Safety Gear	Features	Issues	Primary Stakeholders' Views from Interviews and Testing	When to Wear and Remove as per SOPs (step numbers in process_Annexure 2)	Study Insights	Way Forward for Safety Gear
<p>Barrier cone and Caution Tape</p> 	<p>The barrier cone works as a work in progress indicator. The caution tape did not find much use, as cones were sufficient</p>	<p>The barrier cone can be knocked off by any vehicle passing by, because of its light weight. The barrier cone might be insufficient if the septic tank lid is kept open for a longer duration of time, in case of multiple emptying operations. The barrier cone is used around the vehicle, but there is no physical barricade around the septic tank. A separate set of barrier cones, in a different shape and size, might be required.</p>	<p>In the interview, there is no mention of barrier cone and caution tape. In the testing, they did not find much use for both.</p>	<p>6. Interim parking/ camping at nearest access point (wear) 38. Driver negotiates/receives payment (remove)</p>	<p>A barrier cone by itself does not solve the problem of tertiary stakeholders accidentally falling in the septic tank. There may be other ways to create alertness to the situation, through light and sound alternatives</p>	<p>Suitable for use as is</p> <p>Wheel choke to be added to the list of safety gear</p> <p>Research to be conducted on finding alternatives, preferably audio-visual aids, to accompany barrier cones in safety gear.</p> <p>Research to be conducted on developing effective surrounding barricade for desludging process at night (even though desludging doesn't take place at night, except in emergencies)</p>


Tested Safety Gear	Features	Issues	Primary Stakeholders' Views from Interviews and Testing	When to Wear and Remove as per SOPs (step numbers in process_Annexure 2)	Study Insights	Way Forward for Safety Gear
<p>Hillson Gumboots PVCSG 011</p> 	<p>Gumboots provide protection against foreign objects on the ground. Available in various sizes, so right fit is not a problem</p>	<p>Hampers climbing ladder. Worker will have be careful while washing the pipe after desludging as water may enter. This does not provide any protection around the thigh.</p>	<p>Water/ leakage/ spillage Proof Strong grip on all surfaces Workers The workers prefer gumboots for monsoons, though for their personal reasons. They require open footwear, that should be easy to dry, because if sludge enters the shoes, it will be infectious. Footwear must be grip friendly</p>	<p>9. Open septic tank lid (wear) 40. Parks near the decanting well (wear at these two locations) 37. Cleaning himself (remove) 48. Pipes are put back on the vehicle (remove)</p>	<p>Even though the gumboots protect against thorns and shrubs, they have limited use as they hinder climbing the vehicle and don't resolve the problem of spillage completely. They are not effective for cleaning the septic tank from inside. But detailed observation based studies must be conducted in order to understand the requirement and efficacy of gumboots</p>	<p>Requires adaptation for issues raised during the study Thigh protection must be addressed as a separate design intervention exercise Conduct a time-based user response to safety gear for a time duration of at least 30 days. Based on the responses from this study, further course of action can be charted.</p>

<p>3M Face mask + air purifier gas mask/ chin cortege with 6003 cartridge</p> 	<p>Offers protection from poisonous gases, even when the worker is near the septic tank</p> <p>Prevents inhaling of gases</p> <p>Prevents contact with sludge</p> <p>Available in various sizes, so right fit is not a problem</p>	<p>Canister has to be changed after ESLI turns black</p> <p>Must be worn by the person closer to the septic tank and exposed to the gases</p>	<p>Snug fit Water proof Sound friendly</p> <p>They know that masks are important, but their reasons are for bad odour. They have a misconception that masks only prevent bad odour. A worker wore a mask for two days consecutively, but sweat and mouth saliva mixed with each other to emit a smell that was much worse than the bad odour in the air.</p> <p>But both the masks were well received by the workers. The two major issues of sweating and suffocation have been addressed by the two items of gear recommended by the study. The desludging workers have to be trained for its use, maintenance and care.</p>	<p>9. Open septic tank lid (wear) 37. Cleaning himself (remove)</p> <p>If poisonous gases are not present, then this can be removed and particulate mask can be used.</p>	<p>The present model works well for desludging operations in household septic tank. But air contaminants are not known for septic tanks in commercial places, such as industries, hotels, colleges, schools, community halls, public toilets.</p>	<p>Study must be undertaken to:</p> <ul style="list-style-type: none"> - Identify the air contaminants present in septic tanks of commercial places and public toilets - Determine the air concentration of the contaminant in these septic tanks <p>The study suggests that respirator gas mask with safety goggles for full face must also be considered, purchased and included in the next phase of study, to understand the differences (at various levels) between the two models. Based on the recommendations, further directions can be assessed.</p>
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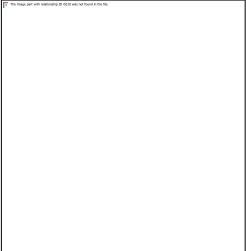
Tested Safety Gear	Features	Issues	Primary Stakeholders' Views from Interviews and Testing	When to Wear and Remove as per SOPs (step numbers in process_Annexure 2)	Study Insights	Way Forward for Safety Gear
3M Breath mask (respirator/particulate mask)- 9332+ 	The soft cotto- like material, when worn and fitted well with the bendable nose bridge, protects from pollutants and other contaminants.	This model can be worn by the second person (one who is away from the septic tank) This must not be worn by the one who is opening the septic tank It has to be worn by one person only and must be changed once the colour changes	Same as above	9. Open septic tank lid (wear) 37. Cleaning himself (remove)	The present model works well for desludging operations in household septic tanks. But air contaminants are not known for septic tanks in commercial places, such as industries, hotels, colleges, schools, community halls, public toilets.	Suitable for use as is Study must be undertaken to: - Identify the air contaminants present in septic tanks of commercial places and public toilets - Determine the air concentration of the contaminant in these septic tanks - Based on the recommendations, further directions can be assessed
	Offers clear vision Protects eye from sweat Stops sludge from entering the eye Covers the eye from all sides, and hence from dust particles and hot gases The elastic holds	This model cannot be worn with the air purifier gas mask. It can be used with particulate mask only. Fogging due to excessive sweating in	Water/ leakage/ spillage proof There was no mention of safety goggles as arequirement for the process, because they can identify the presence of poisonous gases, when their eyes begin to water or experience irritation.	9. Open septic tank lid (wear) 37. Cleaning himself (remove)	This model can be worn when absence of poisonous gases is confirmed. This model can be worn by the second person (one who is away from the	Suitable for use as is Training required for use, care and maintenance

Tested Safety Gear	Features	Issues	Primary Stakeholders' Views from Interviews and Testing	When to Wear and Remove as per SOPs (step numbers in process_Annexure 2)	Study Insights	Way Forward for Safety Gear
3 M 1621 Safety Goggles 2 (Blue frame) 	the goggles in place even while bending down for work. It does not slip off the head, but might wear out in time and may have to be replaced	humid and hot climate and discomfort while at work Prevents sweat from trickling into the eye, but the worker is unable to wipe out his sweat within, due to this the worker often removes them and places them on his head	When they wore it, they felt comfortable, apart from the sweat issue, but they looked at goggles as a style statement		septic tank and wears particulate mask) This does not fit well with the air purifier mask on the face and must not be worn by the one who is opening the septic tank	

Tested Safety Gear	Features	Issues	Primary Stakeholders' Views from Interviews and Testing	When to Wear and Remove as per SOPs (step numbers in process_Annexure 2)	Study Insights	Way Forward for Safety Gear
<p>Udyogi NEOLITE Safety Goggles 1 (black strap)</p> 	<p>Offers clear vision Protects eye from sweat Prevents sludge from entering the eye Covers the eye from all sides, and hence from dust particles and hot gases The elastic holds the goggles in place even while bending down for work. It does not slip off the head; but might wear out in time and may have to be replaced</p>	<p>The frame of the glasses fits snug onto the skin so that the sweat does not trickle in. Unlike the above model, with the smaller surface area the issue of sweat accumulating within the goggles is low. Can be worn with the air purifier gas mask</p>	<p>Water/leakage/spillage proof There was no mention of safety goggles as a requirement for the process, because they can identify the presence of poisonous gases when their eyes begin to water or experience irritation. When they wore it, they felt comfortable, apart from the sweat issue, but they looked at goggles as style statement</p>	<p>9. Open septic tank lid (wear) 37. Cleaning himself (remove)</p>	<p>This model must be worn only with an air purifier mask and by the person who opens the septic tank</p>	<p>Suitable for use as is Training required for use, care and maintenance</p>

<p>KARAM Prokem, Honeywell or BSH Hand gloves (nitrile) (HS101)</p> 	<ul style="list-style-type: none"> • Offers desired protection against: <ol style="list-style-type: none"> 1. Contact with sludge due to spillage while connecting and disconnecting the pipes at various points in the process 2. While removing the pipe from the septic tank after removing the sludge 3. While washing the suction pipe after use 4. While moving the lid of the septic tank • Offers good tactile feedback to be able to conduct the task. • It offered protection from contaminated surfaces like the underside of cement slabs. • The nitrile material provides waterproofing • The material of 	<p>Moving heavy slabs reduces the longevity of the product to less than 1 month. During testing only one size was used. Workers will have to try right size to be able to gauge right fit as snug fit will hinder operations.</p>	<p>Snug fit Water/leakage/ spillage proof Length till elbow with a stopper All-weather proof Tactile feedback for suction hose and instruments Easy to wear Easy to clean Gloves are very important to them, but they are not satisfied with cotton, wool and plastic gloves, that they have used. They suggest one pair of gloves for each desludging operation (at least 3 per day), so that they can be washed and dried. Though they have made this statement in the context of fabric gloves, it holds valid for nitrile gloves, too. This must be considered while deciding the quantities of safety gloves, in the next phase of testing.</p>	<p>14. Bringing the pipe to the septic tank (wear) 37. Cleaning himself (remove) Safety protocols suggest that nitrile gloves must not be used while opening and lifting slabs, but only for the desludging process. The study has allowed the gloves for breaking up the slab and opening the lid and documented feedback for the same.</p>	<p>The identified glove works well for most of the tasks, except it is difficult to find the left and right hand of the pair. Right size is important, as the glove might get stuck while clamping the suction hose to the tank The half hand length is not suitable to avoid complete hand contact with sludge due to spillage and hence elbow length is being recommended.</p>	<p>The study has not been able to procure the elbow-length nitrile glove due to non-availability, hence exact user suitability cannot be determined. It is recommended that:</p> <ul style="list-style-type: none"> - Ideal gloves be procured - User suitability study on the lines of mock testing be conducted - A time-based user response to safety gear for a duration of at least 30 days be conducted <p>Further research has to be done if elbow-length nitrile gloves are available with a 'knurling' feature. If such gloves are not readily available in the market, then design intervention will be required</p>
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	the glove allow it to be cleaned in one quick wash					
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Tested Safety Gear	Features	Issues	Primary Stakeholders' Views from Interviews and Testing	When to Wear and Remove as per SOPs (step numbers in process_Annexure 2)	Study Insights	Way Forward for Safety Gear
<p>Honeywell Four gas monitor – Gasalert Quattro</p> 	<p>Offers desired information to measure hazard Helps to confirm the absence of gases against traditional methods</p>	<p>Considering all the septic tanks during testing had vent pipes, the gas monitor was of limited use. Its effectiveness to be further validated in extreme situations only.</p>	<p>They had seen gas monitors for the first time during the testing and took interest in the same.</p>	<p>11. Assessing for presence of poisonous gases The other end should be dropped into the septic tank but ensure that the hose does not touch the sludge.</p>	<p>The workers expressed their curiosity and interest to use the monitor. Considering the given interface, the product requires training. It must be used with extreme care and caution. Given that it is expensive, not many might not be able to buy it.</p>	<p>Suitable for use as is Training required for use as per code of practice, care and maintenance Other measures include: 1. Check vent pipe 2. Introduce air blowing method 3. Maintain and check record of cleaning schedule 4. Open the seal and leave it for about 5-7 minutes, to let off the poisonous gases 5. Inform clients that there is gas in the tank. 6. Follow safety gear protocols as per operative guidelines</p>

Tested Safety Gear	Features	Issues	Primary Stakeholders' Views from Interviews and Testing	When to Wear and Remove as per SOPs (step numbers in process_Annexure 2)	Study Insights	Way Forward for Safety Gear
Walkie-talkie for communication						In extreme cases, this might be a useful tool. The NAS suggests that this be included in the sample kit for further testing, to validate its efficacy in the desludging process.
Torch						This is a very important tool while looking for blockages in the tank. Though it is recommended by law, the safety audit officer has not seen the necessity for it, but the NAS suggests that this be included in the sample kit for further testing, to validate its efficacy in desludging process.

Tested Safety Gear	Features	Issues	Primary Stakeholders' Views from Interviews and Testing	When to Wear and Remove as per SOPs (step numbers in process_Annexure 2)	Study Insights	Way Forward for Safety Gear
Safety gear for ears and thighs						<p>Requires design. Ears might be a cause of concern while cleaning the septic tank from inside. Further research has to be undertaken to understand the nature of hazard for their health and safety, and design exercise be conducted for the same.</p> <p>Thighs have not been protected by the recommended safety gear. NAS recommends that health and safety hazards be assessed for thighs and design exercise be conducted for protection.</p>

