Research Terms of Reference

Water Trucking Systems in Northwest Syria

SYR1909

Syria

January 2024
Version 1

REACH Informing more effective humanitarian action

1. Executive Summary

Country of intervention	Syria					
Type of Emergency	□	Natural disaster	X	Conflict	□	Other *(specify)*
Type of Crisis	□	Sudden onset	□	Slow onset	X	Protracted
Mandating Body/ Agency	REACH					
IMPACT Project Code	16AXF					
Overall Research Timeframe *(from research design to final outputs / M&E)*	18/07/2023 to 01/04/2024					
Research Timeframe *Add planned deadlines (for first cycle if more than 1)*	1. Pilot/ training: First training: 22/10/2023 First pilot: 23/10/2023 Second training: 14/01/2024			6. Preliminary presentation: NA		
	2. Start collect data: 15/01/2024			7. Outputs sent for validation: 31/03/2024		
	3. Data collected: 31/01/2024			8. Outputs published: 30/04/2024		
	4. Data analysed: 29/02/2024			9. Final presentation: May 2024		
	5. Data sent for validation: 29/02/2024					
Number of assessments	X	Single assessment (one cycle)				
	□	Multi assessment (more than one cycle)				
Humanitarian milestones	**Milestone**			**Deadline (can be tentative)**		
	□	Donor plan/strategy		_ _/_ _/_ _ _ _		
	□	Inter-cluster plan/strategy		_ _/_ _/_ _ _ _		
	X	Cluster plan/strategy		_ _/_ _/_ _ _ _		
	□	NGO platform plan/strategy		_ _/_ _/_ _ _ _		
	□	Other (Specify):		_ _/_ _/_ _ _ _		
Audience Type &	**Audience type**			**Dissemination**		

<table>
<tr><td>Dissemination
Specify who will the assessment inform and how you will disseminate to inform the audience</td><td colspan="2">X Strategic
X Programmatic
□ Operational
□ [Other, Specify]</td><td colspan="2">X General Product Mailing (e.g. mail to NGO consortium; HCT participants; Donors)
X Cluster Mailing (WASH) and presentation of findings at next cluster meeting
X Presentation of findings (at Cluster meeting)
X Website Dissemination (Relief Web & REACH Resource Centre)</td></tr>
<tr><td>Stakeholder mapping</td><td>□</td><td>Yes</td><td>X</td><td>No</td></tr>
<tr><td>General Objective</td><td colspan="4">To provide a comprehensive overview of the costs and effectiveness of private and NGO-led water trucking in Northwest Syria (NWS) in order to inform the WASH cluster’s evidence-based guidelines on water supply in NWS.</td></tr>
<tr><td>Specific Objective(s)</td><td colspan="4">1. Measure the costs of NGO water trucking programs and private water trucking activities.
2. Evaluate the quality of water trucked by NGOs and private vendors as regards safety for human consumption.
3. Assess the adequacy of water supplied to households with respect to minimum WASH standards.</td></tr>
<tr><td>Research Questions</td><td colspan="4">1. What is the cost per person and/or per quantity of water of NGO water trucking programs and of private water trucking activities?
2. How is water trucked by NGOs and private vendors treated, and does it consistently meet the minimum standards for Free Residual Chlorine?
3. Does the water supply from NGO and private water trucking meet or exceed the WASH minimum standards for water and what are the gaps?</td></tr>
<tr><td>Geographic Coverage</td><td colspan="4">Northwest Syria, including the Greater Idleb and Northern Aleppo areas.</td></tr>
<tr><td>Secondary data sources</td><td colspan="4">Secondary data to be collected and submitted to REACH by the NWS WASH cluster. Requested data includes NGO reports on water trucking activities, as well as any available assessments on water trucking and water networks.

Additionally, MSNA data will be used to answer RQ 3.</td></tr>
<tr><td>Population(s)</td><td>X</td><td>IDPs in camp</td><td>X</td><td>IDPs in informal sites</td></tr>
<tr><td>Select all that apply</td><td>X</td><td>IDPs in host communities</td><td>□</td><td>IDPs [Other, Specify]</td></tr>
<tr><td></td><td>□</td><td>Refugees in camp</td><td>□</td><td>Refugees in informal sites</td></tr>
<tr><td></td><td>□</td><td>Refugees in host communities</td><td>□</td><td>Refugees [Other, Specify]</td></tr>
<tr><td></td><td>X</td><td>Host communities</td><td>□</td><td>[Other, Specify]</td></tr>
<tr><td>Stratification
Select type(s) and enter number of strata</td><td>X</td><td>Geographical #: 2
Northern Aleppo, Greater Idleb
Population size per strata is known?
□ Yes X No</td><td>X</td><td>Group #: 2
Private, Public water stations
Population size per strata is known?
□ Yes X No</td><td>□</td><td>[Other Specify] #: _ _
Population size per strata is known?
□ Yes □ No</td></tr>
</table>

Data collection tool(s)	X	Structured (Quantitative)	□	Semi-structured (Qualitative)
	Sampling method		**Data collection method**	
Structured data collection tool # 1 *Select sampling and data collection method and specify target # interviews*	**X Purposive** □ Probability / Simple random □ Probability / Stratified simple random □ Probability / Cluster sampling □ Probability / Stratified cluster sampling □ [Other, Specify]		□ Key informant interview (Target #):_ _ □ Group discussion (Target #):_ _ _ _ _ □ Household interview (Target #):_ _ _ **X Individual interview (Target #): 400** **X Direct observations (Target #): 400** □ [Other, Specify] (Target #):_ _ _ _ _	
Disaggregation by gender and age	Gender		Age	
	□	Yes	□	Yes
	X	No	X	No
Data management platform(s)	X	IMPACT	□	UNHCR
	□	[Other, Specify]		
Expected ouput type(s)	**X**	Situation overview #: 1	□ Report #: _ _	□ Profile #: _ _
	□	Presentation (Preliminary findings) #: _ _	□ Presentation (Final) #: _ _	□ Factsheet #: _ _
	□	Interactive dashboard #:_	□ Webmap #: _ _	□ Map #: _ _
	X	Dataset #: 1		
Access	X	Public (available on REACH resource center and other humanitarian platforms)		
	□	Restricted (bilateral dissemination only upon agreed dissemination list, no publication on REACH or other platforms)		
Visibility *Specify which **logos** should be on outputs*	***REACH***			
	Donor: BHA			
	Coordination Framework: NWS WASH Cluster			
	Partners: Violet, HIHFAD			

2. Rationale

2.1 Background

In Northwest Syria (NWS), households commonly rely on water trucking from private vendors for their water supply. In June 2023, private trucking or a combination of trucking and water networks was reportedly the main source of drinking and domestic water for over half of the 663 assessed communities.[1] At the whole of Syria level, privately trucked water is only inconsistently chlorinated,[2]

[1] REACH (June 2023). Humanitarian Situation Overview in Syria (HSOS) June 2023 for Northwest Syria. https://repository.impact-initiatives.org/document/reach/f6e13aca/REACH_SYR_HSOS_Dataset_June2023_NWS.xlsx

making it vulnerable to contamination with waterborne diseases. It is also generally expensive, with key informants in around half of communities that primarily relied on water trucking or a combination of trucking and networks having reported high prices as a barrier to accessing sufficient water.[1] However, there is a lack of information on how water trucking is managed, including where and how trucks are filled and where they transport their water to, what costs are incurred, and whether the water is safe to drink.

The WASH cluster in NWS approached REACH in April 2023 to propose an assessment of water trucking in NWS in order to better understand how these systems function and what costs are incurred. This will help to inform considerations on the benefit of supporting water trucking efforts versus supporting water network rehabilitation.

2.2 Intended impact

The primary audience for the assessment is the NWS WASH cluster, who proposed this research. Their intended use is to develop evidence-based guidance on water supply systems in NWS. This will help to ensure that WASH partners are supporting safe and cost-effective water supply systems, thus improving access to safe water for the local population. It will also provide an evidence base to identify funding priorities.

3. Methodology

3.1 Methodology overview

The research includes primary data collection and secondary data review.

The aim of the primary data collection is to collect data from water truckers in Northwest Syria, stratified by Area of Influence (Greater Idleb, Northern Aleppo) and by the type of water source they are accessing (private sources or public water stations). As no registry of water truckers is available, the sampling strategy focuses on sampling water sources. For public water stations, data is available and sampling will be done with a probability proportional to the size of the station. For private sources, a preliminary data collection was conducted in almost 1,000 locations to understand the types and locations of water resources. Based on the data collected, communities with water resourced used for trucking will be sampled. Upon arrival in the community, community KIs will be queried about the location of water resources. The survey includes observations of water resources, interviews with water truckers, and water quality testing.

The secondary data review will provide information on NGO-led water trucking and household-level outcomes.

3.2 Population of interest

This assessment covers Northwest Syria (NWS), including Greater Idleb and Northern Aleppo, corresponding to one humanitarian response hub. This area was selected at the request of the NWS WASH Cluster. As the aim is to understand the supply chain for water truckers, the assessment includes NGOs conducting water trucking activities as well as water filling points and water truckers.

[2] UN OCHA (December 2022). Syrian Arab Republic: 2023 Humanitarian Needs Overview (December 2022). https://reliefweb.int/report/syrian-arab-republic/syrian-arab-republic-2023-humanitarian-needs-overview-december-2022-enar

Two units of measurement are used, the individual (water trucker) and the infrastructure (water source).

3.3 Secondary data review

A key secondary source for this assessment is the research conducted by Tufts University,**Error! Bookmark not defined.** which provides a basis for this assessment. In their research, three humanitarian water trucking programs were assessed, one in the Democratic Republic of the Congo and two in Bangladesh. Here, interviews were conducted with programs staff from the NGOs in order to gather information on how the program works. Data collection continued at the water filling point with observations and a random selection of one water trucker. This water trucker was then followed to the distribution point where they were interviewed on the water distribution process. Further observations and water testing were conducted before randomly selecting end users that accessed the distribution point. One group of end users was selected for a Focus Group Discussion the following day, and others were selected for a household survey and water quality testing in the household in order to establish water management practices and perceptions of the program. The qualitative data collected shows how water trucking supply systems function and how they are perceived by various actors in the supply chain. The quantitative data collected allows for a statistical comparison of program performance indicators and humanitarian (Sphere) standards. Due to resource constraints, REACH will reduce the number of data collection activities. Tufts questionnaires form the basis for the data collection tool used.

Household-level data will rely on the Multisectoral Needs Assessment (MSNA) data collected in summer 2023. The MSNA data includes indicators on the primary source of water for drinking, sufficiency of water, and coping with a lack of water. More extensive household-level data collection was conducted during the summer of 2022 by the Humanitarian Needs Assessment Programme (HNAP), which may be used for triangulation.

Further secondary sources can be found here:

Secondary source	**Purpose of source**
Boot, Niall L., Y. Chen, S. Cohen, W. Khayat, and Andre Steele. 2019. “Delivering Sustainable Water Supply in Fragile and Conflict Affected States: Experiences from Syria”. 38th WEDC International Conference, Loughborough University, UK, 2015. https://hdl.handle.net/2134/31162	- Background on the context - Information on costs of water trucking to be used for triangulation
Quintiliano, N. (2021). FCDO EVOLVE Water, Sanitation and Hygiene (WASH) Programme – Final Evaluation Report. SREO Consulting Ltd. https://www.goalus.org/wp-content/uploads/2023/05/FCDO-EVOLVE-WASH.pdf	- Background on the context - Information on costs of water trucking to be used for triangulation
Andreasi Bassi, S., Tange, I., Holm, B., Boldrin, A., & Rygaard, M. (2018). A multi-criteria assessment of water supply in Ugandan refugee settlements. Water, 10(10), 1493. https://doi.org/10.3390/w10101493	- Methodology for life-cycle costing of water supply
Sphere Association (2018). The Sphere Handbook: Humanitarian Charter and Minimum Standards in Humanitarian Response. Fourth edition, Geneva, Switzerland. www.spherestandards.org/handbook	- Minimum standards for water supply, used as a reference point for evaluating effectiveness of water trucking.

Coerver, A., Ewers, L., Fewster, E., Galbraith, D., Gensch, R., Matta, J., Peter, M. (2021). Compendium of Water Supply Technologies in Emergencies. German WASH Network (GWN), University of Applied Sciences and Arts Northwestern Switzerland (FHNW), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA). Berlin, Germany. https://www.washnet.de/wp-content/uploads/2021/09/GWN_Emergency-Water-Compendium_2021_new.pdf	- Safe conduct of water trucking activities.
World Health Organisation (2017). Safely managed drinking water - thematic report on drinking water. Geneva, Switzerland. https://data.unicef.org/wp-content/uploads/2017/03/safely-managed-drinking-water-JMP-2017-1.pdf	- Minimum standards for drinking water supply.

In order to assess NGO water trucking, relevant NGOs will be approached by the WASH cluster and queried for information on their programs. The data provided by these organisations will not be independently verified.

Further information has also been requested from the WASH cluster. This includes any existing indicative or local assessments on private and NGO water trucking, as well as household-level information which will complement the trucker-level data.

3.4 Primary Data Collection

Stratification

Primary data collection will focus on quantitative interviews with water truckers, Free Residual Chlorine tests of their water, as well as observations at the water source. Data will be collected in 4 strata: split between the Areas of Influence “Northern Aleppo” and “Greater Idleb”, and within these areas between truckers accessing private water sources and those accessing public water stations. This stratification was deemed necessary for the following reasons. Firstly, the governance bodies, economic systems, and access to foreign markets differ between Northern Aleppo and Greater Idleb. These differences may impact the cost of trucking operations as well as regulations surrounding water trucking. Secondly, public water stations have a higher degree of regulations, such that it is expected that water quality and thus the cost of accessing the water will differ substantially.

Sample Size

Within each of these strata, varying numbers of truckers will be interviewed (see table below). The benchmark was 100 interviews per strata. This is the required number of interviews needed to achieve representativeness at a 95% confidence level and 10% margin of error under the assumption of random sampling. The sample drawn here is not truly random due to biases in the sampling approach (see below).

Strata	Number of Interviews	Rational
Greater Idleb, Private Sources	100	According to benchmark, see above
Greater Idleb, Public Stations	100	According to benchmark, see above
Northern Aleppo, Private Sources	150	There are only 9 known public stations used for water trucking, compared to over 150 private sources; there is capacity to conduct at least 200 interviews, with the accuracy benefitting the objectives of this assessment.
Northern Aleppo, Public Stations	45	

Sampling at Private Water Sources

There is no existing database for water truckers in NWS, and as such a true random sample is not possible. Instead, sampling for truckers using private water sources will rely on a three-step strategy.

1. Communities are sampled.
   A preliminary data collection was conducted in October 2023 to identify communities with water resources, whether these resources are functional and used by water truckers, and the local importance of these sources (how many households rely on them). Based on this data, a sampling frame will be created. The sampling frame includes communities that:
   a. Were assessed remotely in October 2023;
   b. Are physically accessible to REACH or partner enumerators;
   c. Have functional water resources used for water trucking;
   d. The water resources are relied upon by at minimum “most households in the community.”

   Criterion d. means that truckers accessing smaller water resources are excluded. This is a practical consideration, aimed at increasing the likelihood that a water trucker will be available at the water source when the enumerator arrives.
   Based on this sampling frame, a random sample will be drawn with 100 samples selected for each Greater Idleb and Northern Aleppo. Samples are drawn with replacement, meaning each location can be selected multiple times. The probability of a location being sampled is proportional to the number of water resources used by water truckers in that community.
2. Water sources are identified.
   The data collection tool includes an interview with community KIs on locations of local water resources. The enumerator will select one of the indicated water sources.
3. Water truckers are identified.
   At the water source, enumerators will approach a water trucker. If none is present, they may ask the owner of the water source to contact a trucker. If this is not possible, they will go to the next source in the community.

Please note that while randomly selected, the sample will not be representative as the baseline data is incomplete (excluding water sources further away from communities, and excluding a number of communities) and biased (relying on KI information), and the selection of sources and truckers within the community has a high risk of bias. While the data is not representative of all water truckers across NWS, it may give a strong indication of their situation.

Sampling at Public Water Stations

For public water stations, the Assistance Coordination Unit (ACU) has a database of water stations, their functionality, and the modality of water distribution. Based on this data, a sampling frame will be created. This includes water stations that:

- Were functional;
- Were used by water truckers;
- Are accessible to REACH or partner enumerators.

In Greater Idleb, as there is a sufficient number of eligible water stations, a simple random sample will be drawn with replacements. Given the low number of sources in Northern Aleppo (9), it was decided that 5 interviews would be conducted at each station (see rational above).

Data Collection

Once the water source is accessed, enumerators will observe key details about the source. This includes the type of source, the infrastructure present, and how the source is operated. Thereafter, a trucker accessing the water source will be approached and asked questions about the process of collecting and distributing the water, costs involved, and water treatment. If possible, Free Residual Chlorine levels in water from their trucks will be measured in order to indicate whether water treatment was adequate to protect consumers from waterborne diseases.

Overall, one data collection tool will be designed and programmed into Kobo. This tool will contain two sections, one on observations of the water source, and one on the assessed water trucker. Enumerators will be trained on this tool by REACH.

3.5 Data Processing & Analysis

Data is submitted through enumerators via the KoboCollect App. This data will be downloaded to Excel and cleaned in Excel and R after data collection is finalised. This will focus on identifying duplicate questionnaire submissions, checking that “other” options are valid, identifying outliers for integer-type questions and simple logical checks which were not accounted for in the Kobo tool design. The tool includes text entry questions where enumerators can provide additional information if they feel this is relevant. These entries be processed by the leading SAOs to identify relevant addition information and decide on how to account for this. Follow-ups with the fields team are possible.

The data analysis will be conducted in R, focusing on descriptive statistics. Specifically, for multiple choice questions (select one or select multiple), frequencies with which an option was selected will be reported. For integer type questions, means and medians will be reported. Statistics will be reported at the level of the of the Area of Control level, distinguishing between water trucking from private and public sources.

The data analysis will be published in a publicly accessible Excel file.

A situation overview will be produced, which seeks to answer the three research questions on costs, quality, and sufficiency of water. Presentation of costs will focus on descriptive statistics. Assessment of quality or safety of water is based on UNICEF/ WHO (Joint Monitoring Programme), guidance on safe drinking water, Tufts University study on emergency water trucking, and the Compendium of Water Supply Technologies in Emergencies. The sufficiency of water will be measured against Sphere Standards, which provide the minimum access to water in emergencies.

3.6 Limitations

Key limitations include the lack of information on water truckers. This prevents true random sampling. The sampling approach selected here attempts to approximate a random sample, but introduces the following biases: sampling larger water sources which may be more likely to be safely managed; over-sampling more easily accessible water sources; and sampling only sources close to communities.

For NGO water trucking, the assessment fully relies on NGO-reporting on water trucking programs. There is no way for REACH to check the validity of this information. Furthermore, NGOs may be more likely to submit information to this research if they are confident in the quality and effectiveness of their programs, possibly biasing the data.

The information provided in this assessment is meant to inform WASH guidance on water supply in NWS. A key part of this is households' perceptions of water supplies. However, due to resource constraints, no household-level data collection and no focus group discussions can be conducted at this point, such that perceptions of the local population will not be considered.

Key ethical considerations and related risks

The proposed research design meets / does not meet the following criteria:

The proposed research design…	***Yes/ No***	***Details if no (including mitigation)***
… Has been coordinated with relevant stakeholders to **avoid unnecessary duplication** of data collection efforts?	Yes	
… **Respects respondents, their rights and dignity** (*specifically by: seeking informed consent, designing length of survey/ discussion while being considerate of participants' time, ensuring accurate reporting of information provided*)?	Yes	
… Does not **expose data collectors to any risks as a direct result** of participation in data collection?	No	There is a risk of Unexploded Ordnances (UXOs) and mines at the water source. As sources are regularly accessed by water truckers, this risk is relatively minor. After discussions with country security and enumerators, the risk was deemed to be acceptable. Enumerators will be briefed to ask a local key informant about safety risks at the source prior to accessing it, and only to proceed if they feel comfortable doing so.
… Does not **expose respondents / their communities to any risks as a direct result** of	Yes	

participation in data collection?		
… Does not involve **collecting information on specific topics which may be stressful and/ or re-traumatising** for research participants (both respondents and data collectors)?	Yes	
… Does not involve **data collection with minors** i.e. anyone less than 18 years old?	Yes	
… Does not involve **data collection with other vulnerable groups** e.g. persons with disabilities, victims/ survivors of protection incidents, etc.?	Yes	
… Follows IMPACT SOPs for management of **personally identifiable information**?	Yes	

4. Roles and responsibilities

Task Description	Responsible	Accountable	Consulted	Informed
Research design	Senior Assessment Officer (SAO), Assessment Specialist	Deputy Country Coordinator (DCC)	HQ, WASH Cluster, Data Specialist, Field Manager	
Supervising data collection	SAO	Field Manager		DCC
Data processing (checking, cleaning)	SAO, Data Officer	Data Specialist	HQ	DCC
Data analysis	Data Specialist	Data Specialist	HQ	DCC
Output production	SAO	DCC	HQ, WASH Cluster	/
Dissemination	SAO	DCC	Project Development Officer	/
Monitoring & Evaluation	SAO	DCC	/	/
Lessons learned	SAO	DCC	/	/

Responsible: *the person(s) who executes the task*

Accountable: *the person who validates the completion of the task and is accountable of the final output or milestone*

Consulted: *the person(s) who must be consulted when the task is implemented*

Informed: *the person(s) who need to be informed when the task is completed*

5. Data Analysis Plan

Please see Excel file; for glossary of technical terms, please see Annex 1.

6. Monitoring & Evaluation Plan

IMPACT Objective	External M&E Indicator	Internal M&E Indicator	Focal point	Tool	Will indicator be tracked?
Humanitarian stakeholders are accessing IMPACT products	Number of humanitarian organisations accessing IMPACT services/products Number of individuals accessing IMPACT services/products	# of downloads of x product from Resource Center	Country request to HQ	User_log	X Yes
		# of downloads of x product from Relief Web	Country request to HQ		□ Yes
		# of downloads of x product from Country level platforms	Country team		□ Yes
		# of page clicks on x product from REACH global newsletter	Country request to HQ		X Yes
		# of page clicks on x product from country newsletter, sendingBlue, bit.ly	Country team		X Yes
		# of visits to x webmap/x dashboard	Country request to HQ		□ Yes
IMPACT activities contribute to better program implementation and coordination of the humanitarian response	Number of humanitarian organisations utilizing IMPACT services/products	# references in HPC documents (HNO, SRP, Flash appeals, Cluster/sector strategies)	Country team	Reference_log	X Yes
		# references in single agency documents			X Yes
Humanitarian stakeholders are using IMPACT products	Humanitarian actors use IMPACT evidence/products as a basis for decision making, aid planning and delivery	Perceived relevance of IMPACT country-programs	Country team	Usage_Feedback *and* Usage_Survey template	NA
		Perceived usefulness and influence of IMPACT outputs			NA
		Recommendations to strengthen IMPACT programs			
		Perceived capacity of IMPACT staff			NA

	Number of humanitarian documents (HNO, HRP, cluster/agency strategic plans, etc.) directly informed by IMPACT products	Perceived quality of outputs/programs Recommendations to strengthen IMPACT programs			
Humanitarian stakeholders are engaged in IMPACT programs throughout the research cycle	Number and/or percentage of humanitarian organizations directly contributing to IMPACT programs *(providing resources, participating to presentations, etc.)*	# of organisations providing resources (i.e.staff, vehicles, meeting space, budget, etc.) for activity implementation # of organisations/clusters inputting in research design and joint analysis # of organisations/clusters attending briefings on findings;	Country team	Engagement_log	□ Yes □ Yes X Yes

Annex 1: Glossary of Technical Terms

Public and Private Water Sources

- **Public source:** owned or managed by authorities or NGOs
- **Private source:** owned and managed by a private person or a group of people; if there is no owner (e.g. river), the enumerator should select "private source"

Types of Water Sources

- **Groundwater (boreholes, wells)**: boreholes are small diameter drilled holes used to extract groundwater; wells are large diameter dug hole used to extract groundwater
- **Natural spring:** point where groundwater naturally comes to the surface; this may look like a stream or river, but the water must come from the groundwater, not from rainwater
- **Rainwater (well, dam):** rainwater dam is a man-made dam built to collect rainwater; rainwater well is a large diameter dug hole used to collect rainwater
- **River**: natural flow of water; the water may come from rainfall or groundwater
- **Irrigation canal**: man-made channel of water, built to provide water for irrigation; water may come from rivers, reservoirs, or others
- **Other canal**: man-made channel of water, not built for irrigation; water may come from rivers, reservoirs, or others
- **Lake:** large natural body of water
- **Surface reservoir for groundwater:** man-made lake which is used to store groundwater which is pumped up from a borehole

Truck Features to Protect Water Quality

- **Access port**: entry point for easy access of a person into the water tank (for maintenance, cleaning)
- **Dust-proof lockable covers**: covers any access points into the water tank to prevent any dirt or contaminants from entering the tank; design prevents even small dust particles from entering the tank, lockable to ensure it's securely fastened in place and prevents unauthorised access
- **Screened air vents**: air vents that allow air to leave the tank while filling and air to enter when emptying the tank; screens (such as mesh filters) prevent dirt from entering the tank

Water Treatment Methods

- **Filtration:** water passes through materials that filter out dirt
- **Coagulation and flocculation**: chemicals are added to water that make dirt clump together
- **Sedimentation:** water is left in a tank so that dirt can sink down and settle at the bottom of the tank
- **Treatment with UV light**: UV light is used to disinfect the water
- **Reverse osmosis**: water is pressed through a super fine filter (semi-permeable membrane) to remove salt, bacteria, etc.

Water Testing Methods

- **Turbidity:** tests how many particles are in the water; turbidity is visible through how dirty or cloudy the water looks
- **FRC**: Free Residual Chlorine tests how much chlorine is leftover in the water after treatment
- **E-coli**: E-coli is a bacteria that can cause sickness, such as diarrhoea, stomach cramps, nausea, and vomiting
- **PH:** tests the acidity of water
- **Other organic**: any other tests to detect bacteria and such in water
- **Other inorganic**: any other tests to detect chemicals, heavy metals, minerals and such in water