

THE
CARTER CENTER



A Call for Action: Data on Unexploded Ordnance in Syria and Its Implications

December 2012 – May 2021

March 2022

Contents

Acknowledgements	3
Executive Summary	3
Introduction	5
Main Study	10
Southern Syria	14
Capital Area	16
Northwestern Syria	18
Northeastern Syria	21
Nationwide Study	23
Implications	26
Conclusion	27
Appendix - Terminology	28

Acknowledgements

This report was authored by Hampton Stall, senior program associate, and Hari Prasad, program associate, of the Carter Center's Conflict Resolution Program. The work that informs it was created by a large team of researchers, analysts, and interns. This includes Kate Keator and Jonny Robinson, the creators of much of the underlying data and the authors of previous Carter Center reports on UXO in Syria. It also includes DataWorks at Georgia Tech, Micalie Hunt, and Evan Burger for their assistance in data cleaning.

Executive Summary

The presence of unexploded ordnance (UXO) is a critical impediment to Syria's recovery and development, affecting the ability to farm, use roads, repair housing, or re-enter buildings such as schools or hospitals. Explosive remnants of war have a resounding impact on civilian life, economic activity, and environmental health, making them a crucial issue demanding attention from the international community. The issue is also one of the few common causes among the belligerent parties and their international patrons.

The Carter Center collected and adapted unique and high-quality data, including from the Armed Conflict Location Event Data (ACLED) Project, to assess the likely concentration of UXO sourced from conflict events across Syria dating back to 2012. The result is a quantitative and geographic analysis that can be used to inform recovery efforts and negotiations around these issues writ large.

This data provides the magnitude and details of UXO presence to illustrate why the international community should prioritize this issue and how it can address the problem. Utilizing a novel methodology combined with the Carter Center's and ACLED's unique Syria conflict incident data set, this study recorded at least 972,051 uses of explosive munitions from 99,194 conflict events between December 2012 and May 2021. About 62% (599,954) of the total explosive munitions used in Syria were ground-launched munitions, and 37% (363,807) were air-launched munitions. The findings of the research include the following:

- If a failure rate of between 10% and 30% is applied to these findings, that would mean between **100,000 and 300,000 explosive munitions failed to detonate in Syria between December 2012 and May 2021. (The count is likely much higher.)** For comparison, it took 23 years to clear 86,000 pieces of UXO from Mozambique.

A Call for Action: Syria's Unexploded Ordinance and Its Implications

- Explosive munition contamination in Syria is likely to affect multiple generations of Syrians and its impacts are manifold, including the following:
 - Loss of life or limb through encounters with live munitions years after conflict subsides, particularly among children.
 - Disruptions to economic development, especially related to rebuilding in urban areas and agriculture in rural areas.
 - Environmental degradation as munitions break down and seep chemicals and rust into the ground and groundwater across the country.
- These impacts can and should be mitigated to safeguard civilians, permit humanitarian aid, and ultimately encourage economic recovery. Clearance efforts should not be viewed only in monetary terms and timelines, but as a holistic activity that can encompass humanitarian action, development, confidence-building measures, conflict prevention, and peacebuilding.
- To address this problem set, The Carter Center recommends the following:
 - Address the bureaucratic barriers to humanitarian demining actors (HMAs), including current inhibitive sanctions regimes and lengthy Syrian registration processes. Sanctions waivers should also be provided to HMA organizations to allow them to engage in this crucial work.
 - The international community should prioritize demining efforts alongside other humanitarian endeavors, including in the recovery planning for specific cities for which data can be provided.
 - Utilize solving the problem of UXO as a common theme in which actors could be engaged to move forward on solutions related to resolving the Syria crisis.
 - The government of Syria (GoS) should facilitate a swifter and less arbitrary humanitarian registration process to encourage an earlier start to UXO clearance.
- The Carter Center's methodology allows for analysts and mine action organizations to estimate UXO contamination down to the community level to better concentrate demining efforts. The underlying UXO data should be used by and can be provided to humanitarian organizations to better coordinate demining action and humanitarian aid delivery.

The data set is more detailed than what is presented in this report. The Carter Center is available and willing to share more detailed analysis on this issue with any partners interested in engaging.

Introduction

Since the outbreak of armed conflict in Syria a decade ago, explosive munitions have been deployed extensively by all parties. A portion of these munitions fail to detonate or remain abandoned due to several factors. Unexploded ordnance (UXO) and abandoned explosive ordnance (AXO), alongside landmines and improvised explosive devices (IEDs),¹ form the core deadly threat of explosive remnants of war (ERW) contaminating Syria. ERW pose a threat of bodily harm or death to a population long after the violence of open combat has stopped, continuing to kill and injure for decades while also stoking fear around development and return to a peaceful life.

In usual peacetime situations, several options are presented to those wishing to assess UXO presence. These include on-the-ground assessments, surveys, and clearance operations. These methods are some of the most effective ways to address the physical threat of explosive munitions contamination but can be challenging in Syria today because of security constraints in many parts of the country. The complex international funding pressures on humanitarian entities that respond to explosive munitions (known as humanitarian mine action [HMA] organizations) then further complicate these processes.

Given these restraints, such organizations turn to desk-based studies to prepare for future activities while they wait for conditions on the ground to improve enough to start operations. One such method for accomplishing this is to draw from big data on conflict events to infer the locations and concentrations of potential explosive munitions contamination.

In 2019, the Carter Center's Conflict Resolution Program began working on this complex, multi-generational issue by conducting its own desk-based, nontechnical study. The Center used its unique data set on explosive weapons use in Syria between 2013 and 2019 and an innovative new method (Figure 1) to extrapolate, analyze, and visualize data.

¹ While IEDs are generally considered separate items in this study, it is recognized there is difficulty in their classification in the HMA world. IEDs can share much with AXO, ERW and landmines. For example, a pressure plate-triggered IED can be considered a landmine. An IED that has been placed but fails to detonate can be considered UXO. An IED that has not yet been emplaced could be considered AXO.

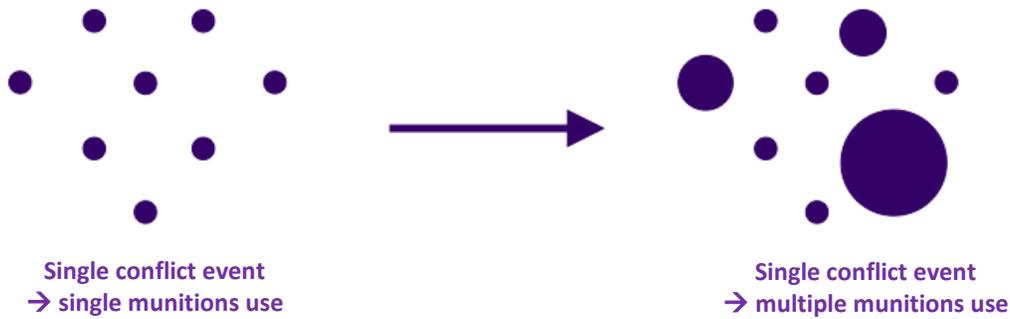


Figure 1. Traditionally, humanitarian mine action entities have used conflict events to count explosive munitions by assuming that one event is equivalent to a single munition event (left). The Carter Center, however, counts the number of munitions used per conflict event to provide a more accurate depiction of potential contamination levels of explosive munitions (right). See our previous reports for further detail on the Center's [methods](#).

Using open-source data, a type that has not typically been used by HMA organizations, the findings provide a window into the scale and complexity of explosive munitions use (and therefore potential contamination) in Syria. It is important to note, though, that it is likely that some incidents have not been recorded. The Carter Center has documented as many verifiable conflict events as possible, but the restrictive reporting environment and sheer level of violence in Syria make getting an exact count extremely difficult.

Through multiple reports focused on different areas of Syria, which can be accessed on the Center's [website](#), the conclusions of this cumulative national study provide information about four broad categories of explosive weapons used in the conflict in Syria: 1) air-launched explosive weapons, 2) ground-launched explosive weapons 3) cluster munitions,² and 4) landmines, IEDs, or UXO (see Figure 2). For ease of use for humanitarian partners, the data uses United Nations Office for the Coordination of Humanitarian Affairs (UNCOHA) mapping standards, which detail locations to the neighborhood level.

This study provides detail and guidance that can be used by entities when planning and prioritizing their work. At the higher level, the study will raise awareness of the complexity and scale of explosive weapons contamination in Syria to operational planners and key decision makers.

The Carter Center, deploying a novel methodology examining our unique data set dating to the onset of armed hostilities, can identify areas of the war-torn country especially suited for focusing demining efforts. The Center holds the unique position of maintaining not only the longest and highest- quality data

² This is counting the number of cluster munition carriers (i.e., containers that carry multiple bomblets) rather than individual bomblets themselves.

from the early period of the Syrian conflict, but the analytical tools and expertise to best tweak models to estimate UXO density across the country. That the Carter Center's data projects supplement the key diplomatic and political work of negotiations and dialogue doubles this impact, providing the insights and urgent findings of Center studies directly to those engaged in building a lasting and safe peace in the country.

Utilizing this novel data approach, The Carter Center has released four nontechnical studies examining the distribution and types of explosive weapons used in Syria between 2013 and 2019.³ The previous studies found an estimated 267,267 uses of explosive munitions throughout most of Syria, affecting at least 2,485 communities. This report updates those findings through a broader temporal scope and an updated methodology. All figures were derived using data collected by The Carter Center and the [Armed Conflict Location & Event Data Project](#) (ACLED).

Impacts of UXO

In 2003, an estimated 60 million landmines and other unexploded ordnance were scattered across 70 countries around the world. At the time, 24,000 people were either injured or killed by these conflict remnants every year.⁴ This number is undoubtedly out of date, as contemporary conflicts in Afghanistan, Iraq, Yemen, and Syria have drastically increased the concentration and geographic spread of UXO contamination in and at the periphery of war zones. The ongoing conflict in Syria has already proved to be a humanitarian catastrophe. The U.N. estimates that there are at least 13 million civilians in Syria who need humanitarian assistance, a staggering number that accounts for about three-quarters of the overall civilian population in the country.⁵ Alongside ongoing armed combat, a crushing socioeconomic downturn, and the exacerbating COVID-19 pandemic, civilians must continue to navigate the hidden threat of UXO. To address this urgent problem, more studies are necessary to better understand the scale and implications of UXO, and resources must be mobilized accordingly to coordinate a response to the crisis.

UXO negatively influences the humanitarian situation along multiple axes:

³ <https://storymaps.arcgis.com/stories/9f69e93367db44fa94a9033214d94d03>,
<https://storymaps.arcgis.com/stories/68427fd196fb461e9631c699fceb13b>,
<https://storymaps.arcgis.com/stories/a5b4613b6a274748b158f6b2f5645b72>,
<https://storymaps.arcgis.com/stories/56eb379077b44eb6912ec0c71c6c8b5e>.

⁴ <https://jamanetwork.com/journals/jama/fullarticle/197009>

⁵ <https://gho.unocha.org/syria>

A Call for Action: Syria's Unexploded Ordinance and Its Implications

1. UXO poses a direct threat to the safety and well-being of civilians, particularly children. As recently as 12 February 2022, two civilians were killed by UXO in Taftanaz, Idlib Governorate.⁶ Just a week earlier, one child died and two others were injured after stumbling across a landmine near al-Hassakah city in northeast Syria.⁷
2. The danger and unpredictability of UXO presence in physical space can and do negatively impact the distribution of humanitarian aid and will greatly hinder any development efforts.
3. UXO needs to be cleared before hospitals, schools, and other vital infrastructure can be rebuilt or re-entered. This has direct economic and health impacts on the livelihood and wellbeing of local communities, impacts that are particularly dire in a country like Syria where the conflict has already destroyed the country's economy and taken hundreds of thousands of lives.
4. UXO also threatens the environment. For Syria, a country that relied on agriculture prior to the conflict, this is particularly damaging. Physical degradation of UXO can contaminate soil and groundwater, both of which are critical elements for Syria's agricultural sector.⁸ Whether through the destruction of buildings or breakdown over time,⁹ the toxic residue from UXO will exacerbate environmental destruction in the country, further harming the livelihoods and wellbeing of Syrians nationwide.

The Carter Center has released four nontechnical reports thus far on UXO contamination in Syria. They cover the following areas and can be accessed through the links below:

- Southern Syria: [Explosive Munitions Contamination, Report 1](#) | [Interactive Map](#)
- Capital Area: [Explosive Munitions Contamination, Report 2](#) | [Interactive Map](#)
- Northwest Syria: [Explosive Munitions Contamination, Report 3](#) | [Interactive Map](#)
- Northeast Syria: [Explosive Munitions Contamination, Report 4](#) | [Interactive Map](#)

The findings of the Center's first four reports demonstrate the importance of mapping out the potential UXO concentration. Not all governorates will have the same level of contamination. Within governorates, the spread of contamination is also uneven. If a failure rate of 10% to 30%¹⁰ is applied to prior Carter Center findings — that 267,267 explosive munitions were used by the close of 2019 — between 26,767 and 80,301

⁶ <https://tinyurl.com/6kvk3ysj>

⁷ <https://tinyurl.com/3n8h7vnd>

⁸ <https://www.epa.gov/enforcement/environmental-challenge-military-munitions-and-federal-facilities>

⁹ <https://aoav.org.uk/wp-content/uploads/2020/04/The-Broken-Land-v4.pdf>

¹⁰ Previous studies on the topic have established that the average rate of failure across explosive types was 10%. A 2005 RAND report on the topic found that in previous conflict zones, 10%-30% of bombs failed to explode in Laos and Cambodia. https://www.rand.org/content/dam/rand/pubs/monographs/2005/RANd_MG244.pdf

A Call for Action: Syria's Unexploded Ordinance and Its Implications

pieces of UXO remain in Syria.¹¹ This estimate represents the minimum level of contamination, as it is derived from reported conflict only. This report serves to summarize the previous studies conducted by The Carter Center, extend the period of study forward, and apply an updated methodology to the dataset.

The clearance of these unexploded munitions will be expensive and time-consuming. For example, it took 23 years to clear 86,000 remnants of war from Mozambique.¹² It took five years to clear 69 of the 186 square kilometers contaminated by UXO in Iraq.¹³ Previous demining efforts in other parts of the world have shown that the process can be time-consuming, requiring decades of time and millions of dollars. However, solving the UXO problem can positively impact Syria's future and greatly outweighs any associated cost. At the local level, demining can help the social and economic empowerment of local communities and assist in post-conflict reconciliation. A U.N.-backed demining effort in southern Lebanon showed that clearing UXO allowed the communities to implement their own development efforts, revitalize local economies, and bring together various political parties and leaders in pursuit of a common goal, ultimately serving as a boon to reconciliation efforts in a post-combat environment.¹⁴ Syria has witnessed some of the worst violence in the 21st century, and the need to reconcile local communities is acute.

All local and international actors present in Syria have a shared interest in improving the humanitarian situation in the country. Demining efforts require multiple logistical inputs, including the import of the necessary equipment, import of foreign or development of local expertise, engagement of UXO discovery and mapping missions, and visa issuance for foreign actors engaging with the tough issue of UXO. While challenging, this can be an opportunity for international powers, mainly Russia and the United States, to collaborate and serve as a confidence-building measure for all major parties involved.

¹¹ https://www.cartercenter.org/resources/pdfs/peace/conflict_resolution/syria-conflict/weapons-contamination-study-rpt-4.pdf

¹² <https://www.mineactionreview.org/assets/downloads/Mozambique-Clearing-the-Mines-2018.pdf>

¹³ https://www.mineactionreview.org/assets/downloads/907_NPA_Clearing_the_Mines_2020_Iraq.pdf

¹⁴ <https://www.un.org/humansecurity/wp-content/uploads/2017/08/Social-economic-empowerment-of-mine-affected-communities-Removing-threat-of-landmines-and-UXOs-and-promoting-post-demining-rehabilitation-in-South-Lebanon.pdf>

Main Study

The Carter Center’s work involves collecting every possible conflict event that that has occurred in Syria since the onset of armed conflict. This is drawn from the Carter Center’s Syria Conflict Mapping Project’s data dating from 2012 and data from the [Armed Conflict Location & Event Data Project](#) (ACLED) dating from 2017. These conflict events were then selected for those including explosive munitions, creating a data set including only aerial bombardment, shelling events, IEDs borne through multiple methods, landmines, and reports of other unexploded ordnance. From this data set of events, The Carter Center then calculated the number of munitions deployed in each event, creating a count of munitions used based upon local reporting numbers or manual counts from video footage where possible. Many events, however, did not have these estimates, so we use a munitions-category-specific estimate for each of these events. This is an improvement over our previous studies, where no-count events received an arbitrary estimate of three shells used, based on the full data set’s assumed average. A data table of these estimates can be found below:

MUNITIONS CATEGORY	TOTAL REAL # EVENTS	AVERAGE (ESTIMATE USED)
AIR-LAUNCHED MUNITIONS	6718	7.78 (8)
CLUSTER MUNITIONS	214	4.05 (4)
GROUND-LAUNCHED MUNITIONS	6250	9.96 (10)
LANDMINES/UXO/IED	5549	1.10 (1)

These averages were then used as a replacement for the estimate for previous events, leading to increases in UXO counts alongside an increase in data accuracy.

As for the burden of estimates across the study data set, the following two visualizations show the level of estimation The Carter Center relies upon to extrapolate munitions use. First, a bar chart showing the level of estimate each of the above listed categories relies upon (top of next page).

Aggregated Estimate by Munitions Category

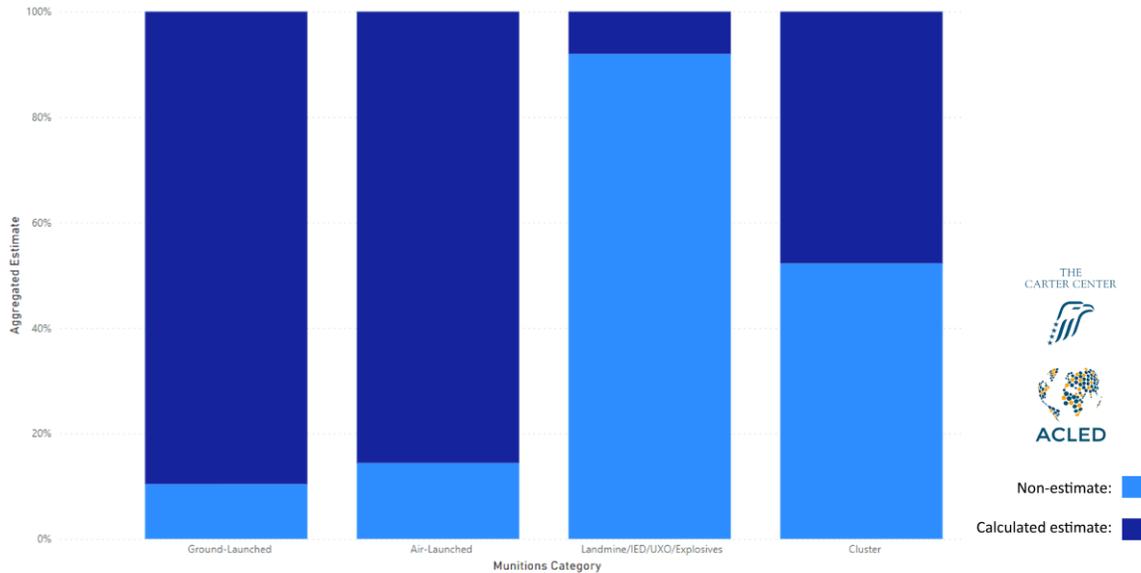


Figure 2. A histogram of data reliance upon extrapolated estimates by munition type.

The high level of estimate requirement for ground-launched and air-launched munitions has to do with several variables. The first is the scale of events related to these two events versus the other two (Landmine/IED/UXO/Explosives and Cluster) – shelling events from mortars and aircraft alike are a major fixture of the combat of the Syrian conflict, even after the cease-fire. Another variable is related to the number of munitions often deployed through these first two modalities versus improvised explosives or landmines — the latter usually results in the deployment of one munition.

These estimates also have a geographic component, as noted in the figure on the following page.

Aggregated Estimate by Governorate

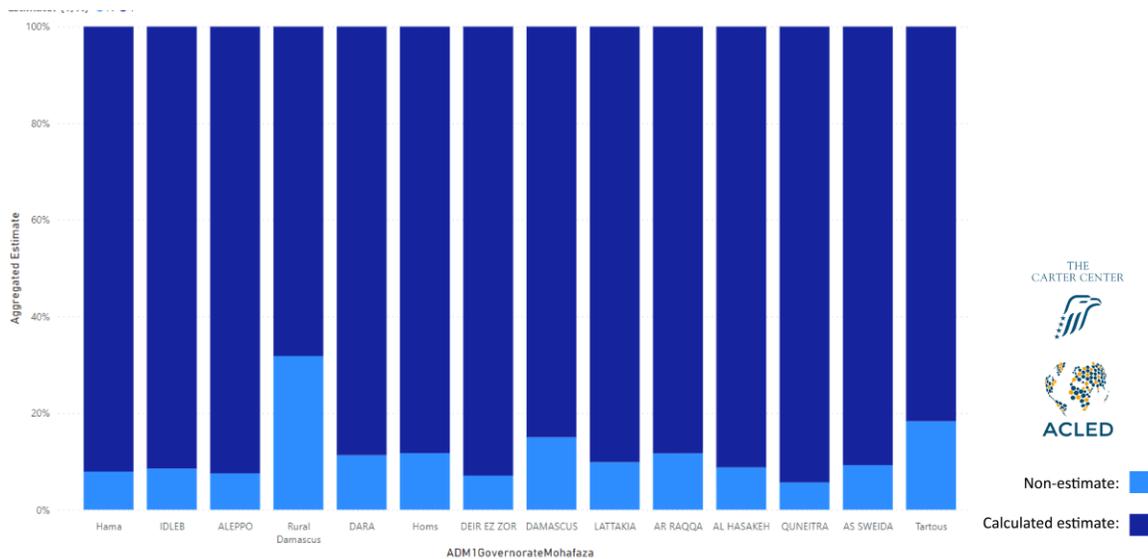


Figure 3. A histogram of data reliance upon extrapolated estimates by governorate.

Rural Damascus, despite the high levels of explosive munitions use within the governorate, also has a heightened level of confirmed munitions deployment. This is likely due to the sourcing of The Carter Center and ACLED. The capital area of Syria has been a site of devoted eyes and ears toward munitions counting, something that is reflected in the data informing this study. The same can’t be said for some of the more rural governorates where munitions counts were less reported and more often lacking an on-the-ground mention of munitions count.

Using primarily open-source data collected by the Carter Center’s Syria Conflict Mapping Project and the [Armed Conflict Location & Event Data Project \(ACLED\)](#), 112,298 conflict events from across Syria produced a minimum count of 403,870 individual uses of explosive munitions in these areas from December 2012 to May 2021. As fighting continues at the time of this writing, this figure is likely to increase.

Based on information from demining specialists, explosive munitions have around a 10%-30% failure rate, driven by several factors. These factors include mechanical failure due to age or landing angle/speed, user error, or any number of other variables. These estimates will be used throughout the

A Call for Action: Syria's Unexploded Ordinance and Its Implications

paper, as mine clearing agencies have more direct experience with UXO and are less bound to lower failure rates than some modern ammunition manufacturers (who usually claim a 2%-5% failure rate).¹⁵

Based on this 10%-30% failure rate of explosives munition, The Carter Center is able to determine an estimated level of munitions use and UXO contribution for each category of explosive munitions deployed in Syria. The table below shows the heavy burden of both air-launched munitions and those deployed from ground-based weapons systems.

ALL OF SYRIA – EXPLOSIVE MUNITIONS COUNT

MUNITIONS CATEGORY	NUMBER OF MUNITIONS	% OF TOTAL	UXO CONTRIBUTION
AIR-LAUNCHED MUNITIONS	363,839	37.4%	36,500-109,250
CLUSTER MUNITIONS (MISC) ¹⁶	1,658	0.2%	150-450
GROUND-LAUNCHED MUNITIONS	599,974	61.7%	60,000-180,000
LANDMINES/UXO/IED	6,633	0.7%	750-2,000

The majority (599,974, nearly 62%) of explosive munitions used in Syria since December 2012 were munitions launched from ground-based systems. All parties to the conflict have access to this type of weaponry, making shelling events widespread throughout all of Syria. However, their use and the use of other explosive munitions types varies across the regions of Syria. The following sections review each region in detail.

¹⁵ <https://sgp.fas.org/crs/weapons/RS22907.pdf>

¹⁶ In the above table, "cluster munitions" account for only about .2% given the munitions category deployed in this paper. However, in the above table and for all following tables in this report, this number only refers to the miscellaneous cluster munitions that have been broken out from air-launched and ground-launched munition sources. There are likely a good deal more than 1,658 cluster munitions deployed throughout the history of the conflict, though their use has been harder to verify than the larger buckets of data provided by deployment modality. This will likely be the focus of future work by The Carter Center and included in future reports.

Southern Syria

- Prior Report: [Explosive Munitions Contamination, Report 1](#) | [Interactive Map](#)
- Governorates Covered: As-Sweida, Daraa, Homs, Quneitra
- Total Munitions Used: 143,785
- Estimated UXO contamination: 14,378-43,136

Although southern Syria has remained under the control of forces associated with the government of Syria (GoS) since 2019, this has not stopped conflict in the region. In Homs Governorate, GoS armed forces and its allies remain active fighting the Islamic State in Iraq and Syria (ISIS) in the Badia desert region, with regular reports of airstrikes and ISIS’s use of landmines and IEDs. As-Sweida and Quneitra Governorates have witnessed their own internal tensions between armed factions and GoS armed groups, as well as regular Israeli airstrikes that reportedly target GoS and Iranian-backed forces. Dara’a Governorate has some of the highest level of conflict with its own combination of tensions between the former opposition and GoS, tribal conflicts, and tensions between As-Sweida and Dara’a armed groups. Although southern Syria has not witnessed levels of violence seen on the frontlines of northern Syria, the use of explosives such as landmines and IEDs remains common.

Around 143,785 munitions were deployed in Southern Syria since December 2012. The majority (92,463, nearly 64%) of explosive munitions used in Southern Syria were launched from ground-launched munition systems. Air-launched munitions made up about 35% (50,231) of all documented explosive munitions used in Southern Syria. Overall, airplane-launched munitions and shelling of unknown types made up over 99% of all documented activity in Southern Syria. See the table below for further details on munitions use in the southern part of the country.

SOUTHERN SYRIA – EXPLOSIVE MUNITIONS COUNT

MUNITIONS CATEGORY	NUMBER OF MUNITIONS	% OF TOTAL	UXO CONTRIBUTION
AIR-LAUNCHED MUNITIONS	50,231	34.9%	5,000-15,000
CLUSTER MUNITIONS (MISC)	109	0.1%	10-30
GROUND-LAUNCHED MUNITIONS	92,463	64.3%	9,250-27,750
LANDMINES/UXO/IED	982	0.7%	100-300

Explosive munitions used in Southern Syria vary in concentration, as shown by the heat map below. Major campaigns for the northern countryside of Homs or protracted conflict around Daraa city, for example, have led to high concentrations of expected unexploded ordnance in those areas.

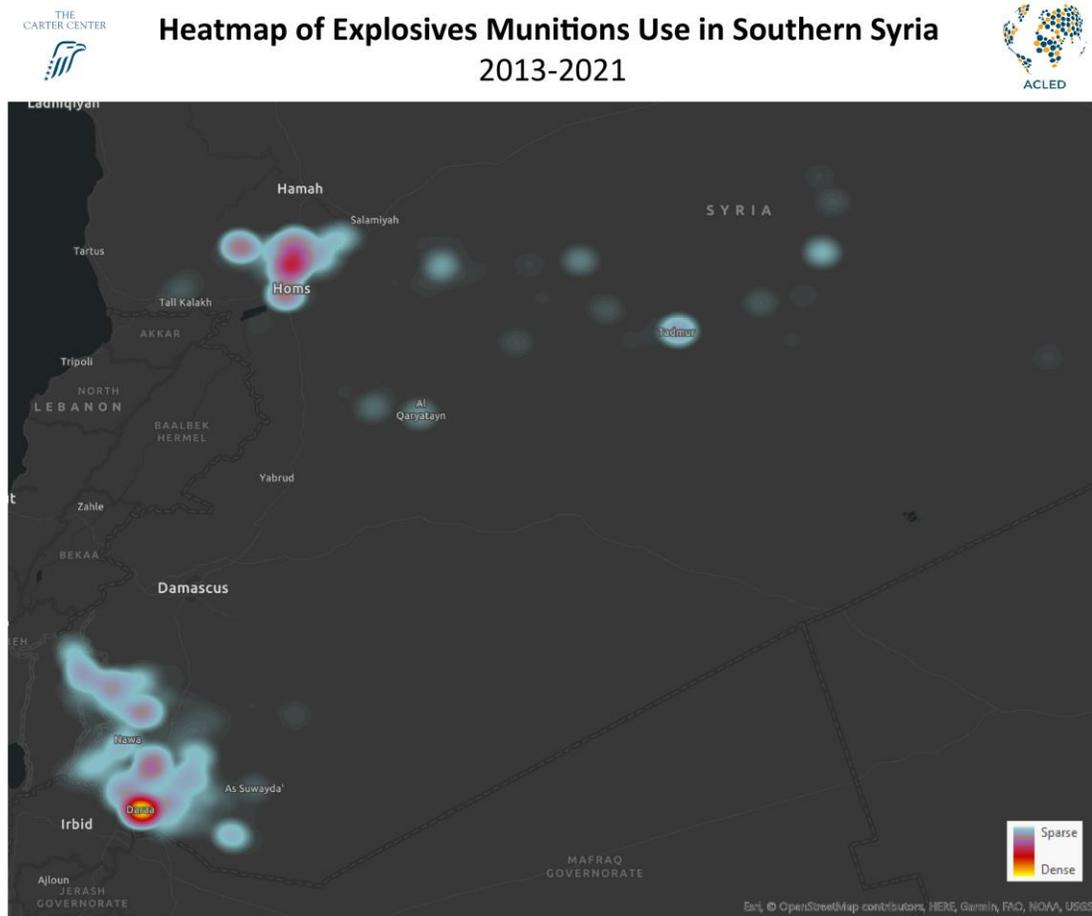


Figure 4. Explosive munitions use density across Syria's Southern Area (excluding the Capital Area).

A table of explosive munitions use and expected UXO contamination by governorate is produced in the table on the following page, showing a heavy distribution of UXO in both Daraa and Homs governorates.

SOUTHERN SYRIA – EXPLOSIVE MUNITIONS BY GOVERNORATE

GOVERNORATE	NUMBER OF MUNITIONS	% OF TOTAL	UXO CONTAMINATION
AS-SWEIDA	2,101	1.5%	200-625
DARAA	78,031	54.3%	7,750-23,500
HOMS	51,851	36.1%	1,200-3,500
QUNEITRA	11,802	8.2%	100-300

It is critical to remove unexploded ordnance in Southern Syria for several reasons. Southern Syria serves as a crucial area for Syria’s cross-border trade and the flow of humanitarian aid into the country. The M5 highway that runs from the Jordanian capital of Amman all the way to Syria’s crucial pre-war economic center, Aleppo in the northwest, is crucial connective infrastructure that runs through UXO- contaminated areas in Southern Syria. Notably, Jordanian exports of gravel, a key component in concrete, will likely need to be shipped along this highway to provide supplies to many development and repair efforts, not just in Southern Syria but throughout the country.

Capital Area

- Prior Report: [Explosive Munitions Contamination, Report 2](#) | [Interactive Map](#)
- Governorates Covered: Damascus, Rural Damascus
- Total Munitions Used: 184,786
- Estimated UXO contamination: 18,500 – 55,500

Rural Damascus and Damascus city have remained under strong Government of Syria control and have experienced comparably little conflict compared to other regions of Syria since 2019. Indeed, the use of munitions continues primarily due to Israeli airstrikes and anti-aircraft systems attempting to stop the missiles. Despite this relative calm, tensions remain. GoS armed forces continue to arrest suspected former opposition fighters and work to assert their control over the population. The risk of further escalation remains.

A Call for Action: Syria's Unexploded Ordnance and Its Implications

Around 184,786 munitions were deployed in the Syrian Capital Area since December 2012. The majority (125,677, nearly 68%) of explosive munitions used in the region were launched from ground-launched munition systems. Air-launched munitions made up about 32% (58,465) of all documented explosive munitions used in Damascus and Rural Damascus. See the table below for further details on munitions use around the capital.

SYRIAN CAPITAL AREA – EXPLOSIVE MUNITIONS COUNT

MUNITIONS CATEGORY	NUMBER OF MUNITIONS	% OF TOTAL	UXO CONTRIBUTION
AIR-LAUNCHED MUNITIONS	58,465	31.6%	5,750-17,500
CLUSTER MUNITIONS (MISC)	163	0.1%	25-50
GROUND-LAUNCHED MUNITIONS	125,677	68.0%	12,500-37,750
LANDMINES/UXO/IED	481	0.2%	50-150

A heat map of UXO concentration is reproduced in a map below:

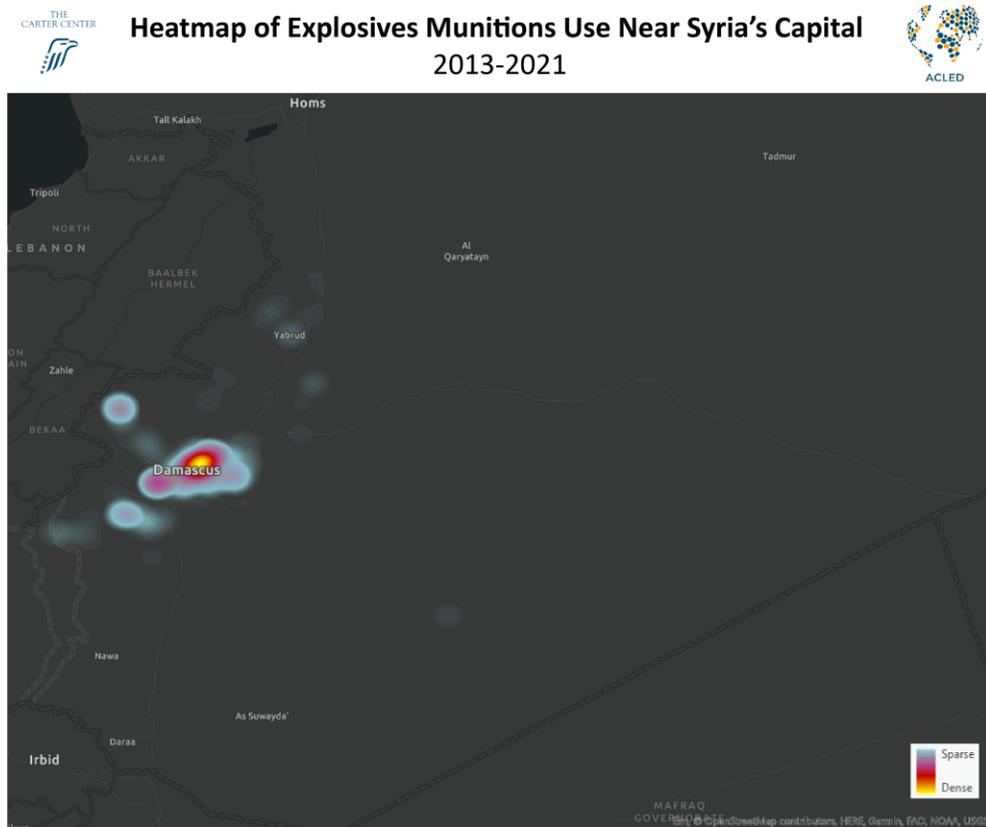


Figure 5. Explosive munitions use density across Syria's Capital Area.

Explosive munitions used in Syria’s Capital Area vary in concentration, as shown by the heat map above. The division of explosive munitions use varies between the city of Damascus and its countryside, as shown in the table below, showing a heavy distribution in Rural Damascus.

SYRIAN CAPITAL AREA – EXPLOSIVE MUNITIONS BY GOVERNORATE

GOVERNORATE	NUMBER OF MUNITIONS	% OF TOTAL	UXO CONTAMINATION
DAMASCUS	31,744	17.2%	3,000-9,500
RURAL DAMASCUS	153,042	82.8%	15,250-46,000

It is critical to remove unexploded ordnance in the Capital Area of Syria, if for no other reason than that Damascus is a highly populated area and substantial UXO presence presents potentially lethal risk to those who live in the area, visit the area, or move to the area in the future. This is especially the case as the Syrian government presents Damascus as secure and calls for more development and commerce in the capital city.

Northwestern Syria

- Prior Report: [Explosive Munitions Contamination, Report 3](#) | [Interactive Map](#)
- Governorates Covered: Aleppo, Hama, Idleb, Latakia, Tartous
- Total Munitions Used: 569,211
- Estimated UXO contamination: 57,000 – 170,750

According to the Carter Center/ACLED conflict event database, northwest Syria remains the most active battlefield in the country. Between December 2019 and March 2020, the government of Syria and its allies launched a new military operation to retake opposition-controlled territories. The operation ended after Turkey attacked GoS forces in retaliation for the killing of Turkish soldiers.¹⁷ Since then, a cease-fire has largely held in Northwest Syria resulting in few frontline changes. Despite this, conflict continues with active artillery shelling, clashes, and airstrikes being reported from the region. Currently, the conflict in the region

¹⁷ <https://www.brusselstimes.com/97924/turkey-launches-offensive-against-syrian-regime>

A Call for Action: Syria’s Unexploded Ordinance and Its Implications

can be sorted into six categories. First, the fighting between Hayat Tahrir al-Sham (HTS) and its allies against pro-government forces in Latakia, Hama, and Idlib governorates. Second, Turkey and the Turkish-backed Syrian National Army (SNA) conflict against GoS and the Kurdish-led Syrian Democratic Forces (SDF) in Aleppo Governorate. Third, the Kurdish insurgency in Turkish-held Aleppo Governorate. Fourth, HTS’s crackdown on rival groups in territories under its control. Fifth, infighting among the SNA in Turkish-held Aleppo Governorate. Sixth and finally, the continuing fight against the Islamic State, most notably in the eastern part of Hama Governorate. Nearly all of these entail heavy use of explosives by the belligerents, which has added to the UXO contamination in the Northwest and had a heavy impact on civilian lives.

Around 569,211 munitions were deployed in Northwestern Syria since December 2012. The majority (348,329, nearly 62%) of explosive munitions used in Northwestern Syria were launched from ground-launched munition systems. Air-launched munitions made up about 38% (216,806) of all documented explosive munitions used in Northeastern Syria. Overall, airplane-launched munitions and ground launched munitions made up over 99% of all documented activity in Northwestern Syria. See the table below for further details on munitions uses in the northwestern part of the country.

NORTHWESTERN SYRIA – EXPLOSIVE MUNITIONS COUNT

MUNITIONS CATEGORY	NUMBER OF MUNITIONS	% OF TOTAL	UXO CONTRIBUTION
AIR-LAUNCHED MUNITIONS	216,806	38.1%	21,750-65,000
CLUSTER MUNITIONS (MISC)	1,386	0.2%	150-425
GROUND-LAUNCHED MUNITIONS	348,329	61.2%	34,750-104,500
LANDMINES/UXO/IED	2,690	0.5%	250-800

UXO contamination across Northwestern Syria has a geographic specificity to it, too, of course. This is displayed across the region in the heat map on the following page:

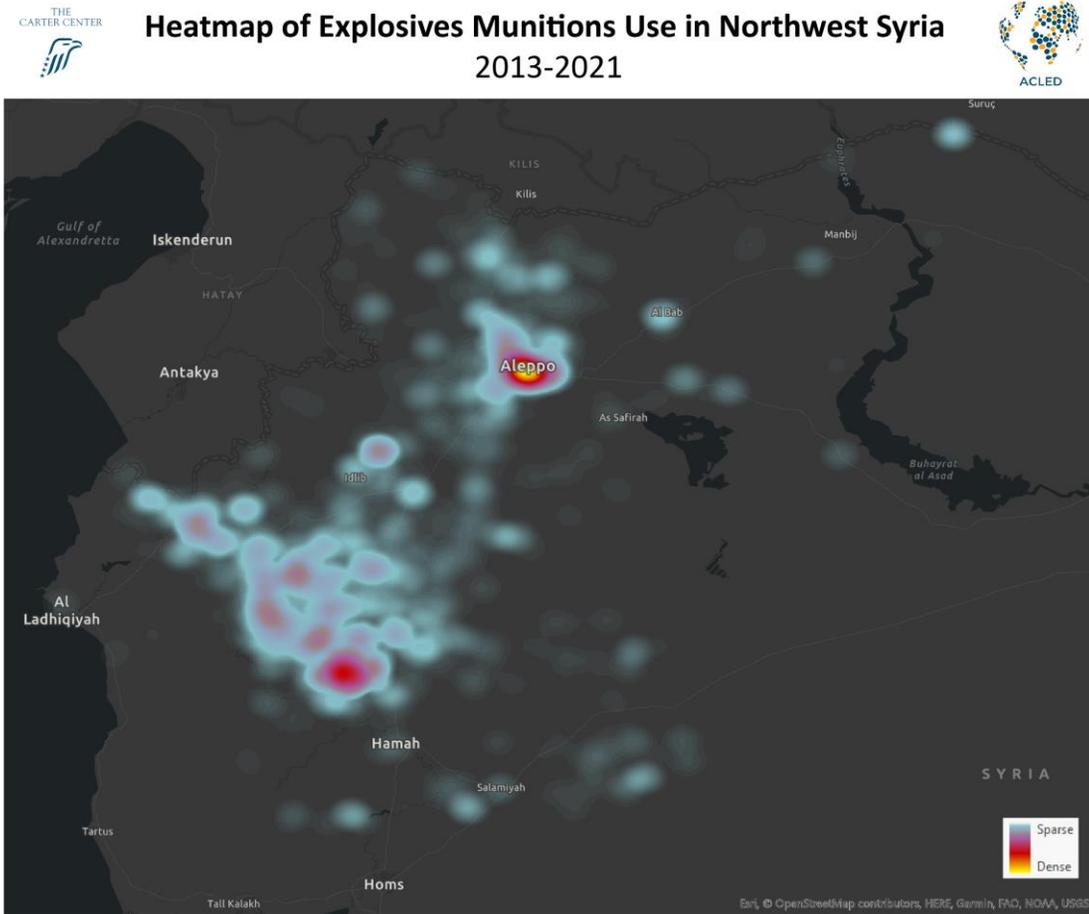


Figure 6. Heatmap of explosive munitions use across Northwestern Syria.

NORTHWESTERN SYRIA – EXPLOSIVE MUNITIONS BY GOVERNORATE

GOVERNORATE	NUMBER OF MUNITIONS	% OF TOTAL	UXO CONTAMINATION
ALEPPO	172,039	30.2%	17,250-51,500
HAMA	188,994	33.2%	19,000-56,750
IDLEB	177,027	31.1%	17,750-53,000
LATTAKIA	31,080	5.5%	3,000-9,250
TARTOUS	71	0.01%	0-50

Before the Syrian conflict began, Northwestern Syria hosted crucial economic centers, such as Aleppo city. These locations, where middle-class jobs and business activities were common, were also surrounded by critical farmland and electrical infrastructure. All these sectors of activity — private and public economic activity alike — have been heavily disrupted by open conflict and the destruction caused

by conflict. UXO contamination hinders recovery both directly through detonations that continue today and indirectly through the psychological effects of the perceived threat of UXO waiting for an unlucky passer-by. In addition, Idlib Governorate now hosts one of the largest IDP populations in the country. Alongside other factors, the continued high level of conflict and contamination puts these civilians at even higher risk.

Northeastern Syria

- Prior Report: [Explosive Munitions Contamination, Report 4](#) | [Interactive Map](#)
- Governorates Covered: Al Hassakeh, Ar-Raqqa, and Deir-ez-Zor
- Total Munitions Used: 74,269
- Estimated UXO contamination: 7,250-22,250

The fourth UXO report, examining Northeast Syria, detailed UXO contamination in the region between October 2013 and May 2019. Shortly after this period, Turkey and its Syrian National Army allies launched Operation Peace Spring, conquering parts of Ar-Raqqa and Deir-ez-Zor governorates. Facing increasing pressure from the Turkish operation, the SDF struck a deal with Russia to allow armed groups associated with Russia and the government of Syria to deploy along some of these key frontlines. This bargain between the SDF and GoS has been fragile, with mutual distrust and occasional conflict erupting between the two parties. Although there have been few frontline changes in the region, artillery and air-launched munitions continue to be used in the frontline areas between Turkish-held and SDF-controlled territory. Away from the Turkey-SDF conflict, forces associated with the Islamic State in Iraq and Syria continue to be active despite no longer controlling territory. The SDF and its international allies, most notably U.S. armed forces, continue to conduct operations targeting suspected ISIS fighters and sleeper cells. This has been complemented by GoS and Russian operations in the Badia desert region, particularly in Deir-ez-Zor Governorate.

Around 74,269 explosive munitions were deployed in Northeastern Syria since December 2012. A slim majority (38,305, just under 52%) of explosive munitions used in the region were air-launched munitions. Slightly below that are ground-launched munitions, which account for just over 45% of all explosive munitions used in Northeastern Syria. Combined, air-launched and ground-launched munitions

A Call for Action: Syria's Unexploded Ordnance and Its Implications

account for as many as 21,500 explosive remnants of war in this region of Syria alone. See the table below for further details on munitions uses in the northeastern part of the country.

NORTHEASTERN SYRIA – EXPLOSIVE MUNITIONS COUNT

MUNITIONS CATEGORY	NUMBER OF MUNITIONS	% OF TOTAL	UXO CONTRIBUTION
AIR-LAUNCHED MUNITIONS	38,305	51.6%	3,750-11,500
GROUND-LAUNCHED MUNITIONS	33,485	45.1%	3,250-10,000
LANDMINES/UXO/IED	2,479	3.3%	250-750

These munitions are heavily concentrated around a few areas of Syria's Northeast, as shown in a heat map displayed below:

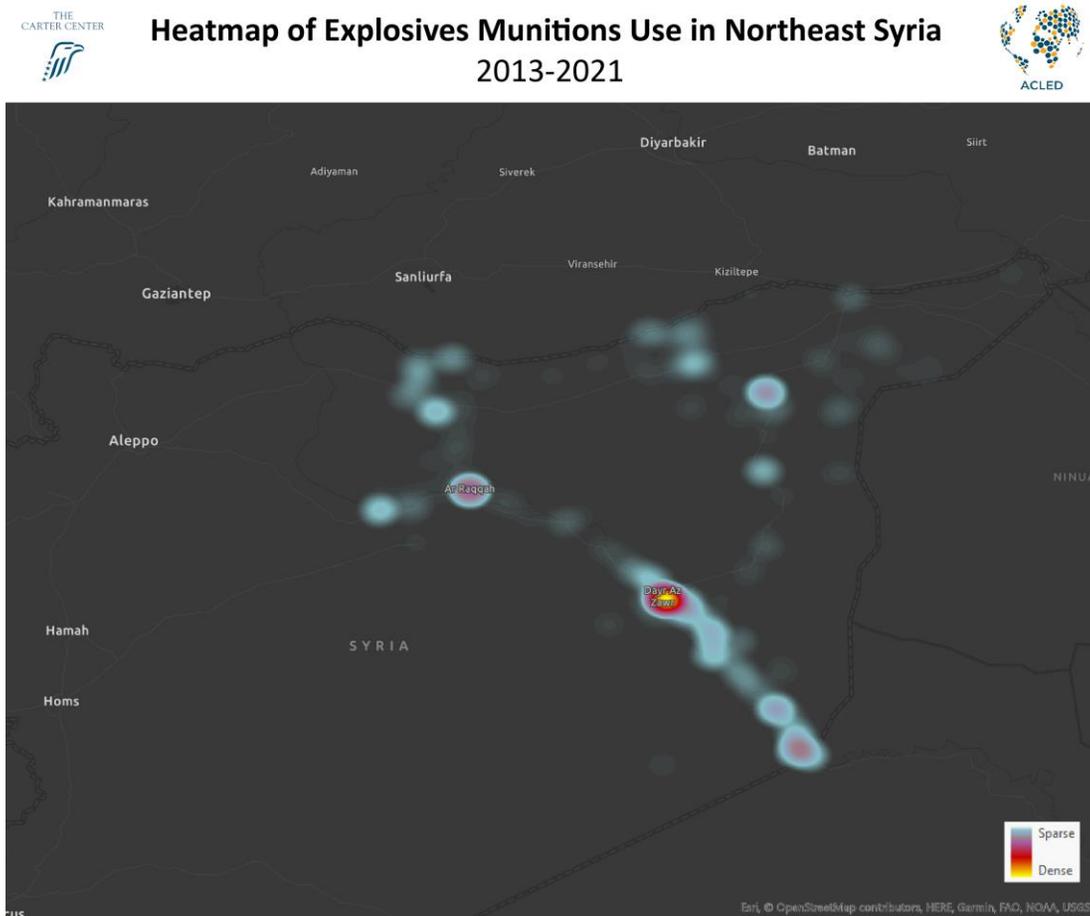


Figure 7. Concentrations of explosive munitions use in Northeastern Syria.

Explosive munitions used in Northeastern Syria vary in concentration, as shown by the heat map above. Major campaigns against ISIS, for example, have led to high concentrations of expected unexploded ordnance in areas held by the group — namely the group’s claimed capital city of Raqqah and latter urban holdout in Deir-ez-Zor. Like the Northwest, Turkish engagement in Syria’s Northeast against the YPG-led Syrian Democratic Forces has led to likely deposits of UXO throughout the border region of Syria’s north.

A table of explosive munitions use and expected UXO contamination by governorate is produced in the table below, quantifying the heavy distribution of UXO in Deir-Ez-Zor Governorate especially.

NORTHEASTERN SYRIA – EXPLOSIVE MUNITIONS BY GOVERNORATE

GOVERNORATE	NUMBER OF MUNITIONS	% OF TOTAL	UXO CONTAMINATION
AL HASAKEH	15,408	20.7%	1,500-4,500
AR RAQQA	18,910	25.5%	1,750-5,750
DEIR-EZ-ZOR	39,951	54.8%	4,000-12,000

The Syrian Democratic Forces (SDF) have documented their clearing of unexploded ordnance in territories they hold in Northeastern Syria. This has been crucial work, especially given the reality that much of the territory of the north that they hold had been booby-trapped by retreating ISIS members before being retaken by the SDF. It is critical, however, to continue the removal of unexploded ordnance in Northeastern Syria. The region has been a crucial agricultural center for Syria, and UXO contamination slows the return to agricultural production due to fears that tillers and other agricultural equipment may strike and thus set off unexploded ordnance buried in the soil. Deir-ez-Zor, where the bulk of UXO contamination lies in the Northeast, is also home to several small to moderate crude oil fields. The production of oil — and the crucial tax revenue that comes along with it — will likely be instrumental in the reconstruction and development of Syria’s Northeast, and fears around UXO presence will hinder this engagement.

Nationwide Study

Through the analysis of nearly 100,000 conflict events in Syria gathered through extensive open-source investigation by The Carter Center and the substantial data set provided by the Armed Conflict

A Call for Action: Syria's Unexploded Ordnance and Its Implications

Location Event Data (ACLED) Project, The Carter Center has estimated that at least 972,051 explosive munitions have been used in about eight years of conflict. This number is more likely to be well over 1 million but is also likely to be spread out over a similar geographic distribution as documented here. Below is the number of estimated explosive munitions used in each governorate of Syria, its percentage of the total, and the estimated contamination range of unexploded ordnance for each.

ALL OF SYRIA – EXPLOSIVE MUNITIONS BY GOVERNORATE

GOVERNORATE	NUMBER OF MUNITIONS	% OF TOTAL	UXO CONTAMINATION
AL HASAKEH	15,408	1.6%	1,500-4,500
ALEPPO	172,039	17.7%	17,250-51,750
AR RAQQA	18,910	1.9%	1,750-5,750
AS SWEIDA	2,101	0.2%	250-750
DAMASCUS	31,744	3.3%	3,250-9,500
DARAA	78,031	8.0%	7,750-23,500
DEIR-EZ-ZOR	39,951	4.1%	4,000-12,000
HAMA	188,994	19.4%	19,000-56,750
HOMS	51,851	5.3%	5,250-15,500
IDLEB	177,027	18.2%	17,750-53,000
LATTAKIA	31,080	3.2%	3,000-9,250
QUNEITRA	11,802	1.2%	1,250-3,500
RURAL DAMASCUS	153,042	15.7%	15,250-46,000
TARTOUS	71	0.007%	7-25

This data is also similarly displayed geospatially in a nationwide map for reference on the next page in a heat map generated from all confirmable geotagged data informing this report.

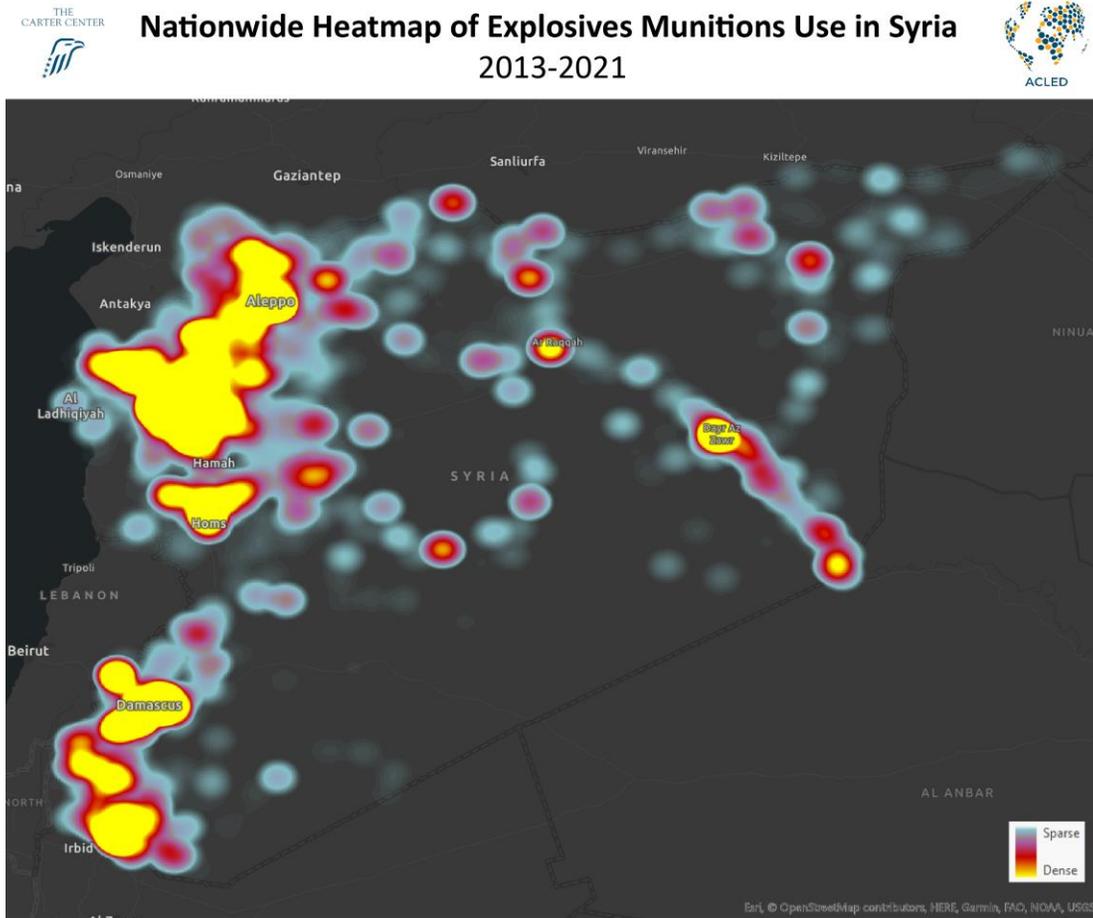


Figure 8. Heat map of explosive munitions use nationwide in Syria.

As with regional summaries that precede this section, the burden of munitions by category is reproduced in a full table summary below. Note here that “Cluster Munitions” does not refer to all cluster munitions used, but instead those which could not be immediately confirmed as originating from either ground or air sources.

ALL OF SYRIA – EXPLOSIVE MUNITIONS BY CATEGORY

GOVERNORATE	NUMBER OF MUNITIONS	% OF TOTAL	UXO CONTRIBUTION
AIR-LAUNCHED MUNITIONS	363,807	37.4%	36,500-109,250
CLUSTER MUNITIONS (MISC)	1,658	0.2%	150-500
GROUND-LAUNCHED MUNITIONS	599,954	61.7%	60,000-180,000
LANDMINES/IED/UXO	6,632	0.7%	750-2,000

Implications

Unexploded Ordnance (UXO) clearance is an urgent matter, compounded by the numerous issues already plaguing Syria. These issues, related to poor economic activity, the COVID-19 pandemic, and mass displacement, all intersect and interact with the problem of major UXO contamination.

The Carter Center has already held workshops related to this issue and plans to host more in the future, but major inhibitors to UXO clearance have already been identified. The restrictive sanctions environment makes it extremely difficult to operate in Syria, a reality that is made more complicated by government restrictions on humanitarian actors. Not only does the government control over half of all territory in Syria and thereby necessitate clearing activities in its territorial holdings, but the bureaucratic barriers to humanitarian demining actors (HMAs) operating in any territory of Syria remain high. Western donors will likely be crucial to UXO clearance funding, complicated by both this sanctions regime and the lengthy registration process in Damascus. UXO clearance is an awkward elephant in the room that hinders further humanitarian assistance to Syria, yet it is not a major priority within the international discourse regarding the conflict.

Demining and UXO clearance, however, could be an important avenue for confidence-building measures between Syrian actors and their opposing international supporters alike. Regardless of one's political views toward the situation in Syria, no side benefits from UXO presence and all are impacted by contamination with explosive remnants of war. Collaboration on explosives clearing is something that has come up in Carter Center-hosted workshops on the matter.

These observations and realities therefore result in a short list of recommendations from the Carter Center's Syria Project:

1. International collaboration on explosives clearing is worthwhile and should be pursued by all parties to the conflict and their patrons.
2. The Western international community should work to reduce sanctions that inhibit demining efforts and humanitarian endeavors; in return, the Syrian government should facilitate humanitarian registration and the purveyance of licenses to make it easier for HMAs to operate in Syria.

Conclusion

The findings in this analysis provide operational planners guidance for the prioritization of humanitarian mine action activity, especially with respect to directing finer on-the-ground surveys, clearance operations, and risk-education programs. It can also serve as a preliminary guide to assess risk for staff doing this clearance on the ground. It helps illustrate the scale and complexity of potential explosive munitions contamination across all of Syria, helpful for strategic-level engagement, especially with political and donor advocacy.

The scale of this issue deserves urgent attention from those looking to limit harms against civilian populations in Syria. Applying the baseline failure rate of 10% to these explosive munitions, there are a minimum of 97,250 unexploded munitions in Syria, a number that grows to nearly 300,000 when using the upper end failure rate put forward by demining experts.

In [Iraq](#) it took three years to destroy 11,549 UXO and landmines in federal and Kurdish Regional Government-controlled parts of the country. The scale of UXO contamination in Syria is perhaps 10 times higher than what was cleared in those three years, and this issue is likely to plague the everyday lives of Syrians for decades to come.

Demining is a process outside of the politics of Syria and factions' international patrons. International actors, many of whom have directly contributed to the likely UXO contamination throughout the country, have not only an obligation to engage in efforts to remove UXO in Syria but also may be able to use removal as an opportunity to engage in conflict transformation through a rare opportunity for strategic alignment of their own defense departments and the armed groups they support.

Appendix - Terminology

Terminology used in the explosive weapons clearance and demining field is highly specialized and often used loosely outside the sector. The following section highlights commonly used terms in this study and the demining field. Definitions for these terms were compiled from [International Mine Action Standards \(IMAS 04.10\) Second Edition \(May 2013\)](#) as well as from [Conflict Event Data and Beyond](#) from World Bank Training Workshop, March 2018.

Ammunition, munition, or munitions are complete devices charged with explosives, propellants, pyrotechnics, initiating composition, or nuclear, biological, or chemical material for use in military operations, including demolition. In common usage, “munitions” are often referred to as military weapons, ammunition, and equipment.

Clearance in the context of mine action refers to the tasks or actions to ensure the removal and/or the destruction of all mine and ERW (see below) hazards from a specified area to a specified depth.

Cluster Munition(s) refers to a conventional munition that is designed to disperse or release explosive submunitions that each weigh less than 20kg and includes those explosive submunitions. It does not include a) munition or submunition designed to dispense flares, smoke, pyrotechnics, or chaff, or a munition designed exclusively for an air defense role; b) a munition or submunition designed to produce electrical or electronic effects; c) a munition that, in order to avoid indiscriminate area effects and the risks posed by unexploded submunitions, has all of the following characteristics (i) each munition contains fewer than 10 explosive submunitions; (ii) each explosive submunition weighs more than 4kg; (iii) each explosive submunition is designed to detect and engage a single target object; (iv) each explosive submunition is equipped with an electronic self-destruction mechanism; and (v) each explosive submunition is equipped with an electronic self-deactivating feature.

Demining involves activities that lead to the removal of mine and ERW hazards, including technical survey, mapping, clearance, marking, post-clearance, documentation, community mine action liaising and handover of cleared land. International Mine Actions Standards (IMAS) considers mine and explosive remnants of war (ERW) clearance one part of the demining process.

Explosive Ordnance Disposal (EOD) is the detection, identification, evaluation, rendering safe, recovery, and disposal of explosive ordnance or munitions.

A Call for Action: Syria's Unexploded Ordnance and Its Implications

Explosive Ordnance (EO) or munitions refers to all munitions containing explosives, nuclear fission or fusion materials, and biological and chemical agents. This includes a broad range of weapons that use components that are explosive in nature, such as bombs and warheads; guided and ballistic missiles; artillery, mortar, rocket, and small-arms ammunition; all mines, torpedoes, and depth charges; pyrotechnics; clusters and dispensers; clandestine and improvised explosive devices. The explosive munitions included in this study are airstrikes, incendiary airstrikes, barrel bombs, cluster munitions, drone attacks, rockets, improvised rockets, incendiary rockets, artillery, incendiary artillery, tank shelling, mortars, shelling of unknown type, incendiary shelling, anti-tank guided missiles (ATGM), rocket-propelled grenades (RPG), grenades, suicide vehicle-borne improvised explosive devices (SVBIEDs), vehicle-borne improvised explosive devices (VBIEDs), person-borne improvised explosive devices (PBIED), improvised explosive devices (IED), unidentified explosives, landmines, and unexploded ordnance of unidentified type (UXO).

Explosive Remnants of War (ERW) refers to both abandoned explosive ordnance and unexploded ordnance (UXO), though not landmines. These are all explosive munitions left behind after a conflict and can be used or unused. This includes conventional ground- and air-launched explosive weapons, such as artillery and cluster munitions, as well as improvised weapons.

Improvised Explosive Device(s) (IED) are devices placed or fabricated in a makeshift or improvised manner (with whatever materials are available) incorporating explosive material, destructive, lethal, noxious, incendiary, pyrotechnic materials, or chemicals designed to destroy, disfigure, distract, or harass.

Landmines are explosive devices designed to lie hidden in an area (sometimes for years) and kill or injure people who trigger them. These victim-triggered devices can be classified as anti-personnel, which are activated by a person or animal stepping on them, or anti-vehicle, which are activated when a vehicle drives over them. The International Mine Ban Treaty prohibits their use, and their clearance is conducted in a specialized way. Increasingly, this category covers improvised explosive devices (IEDs), which act as improvised landmines as they are also typically victim-triggered.

Unexploded Ordnance (UXO) refers to munitions that are used in conflict and for some reason fail or partially fail to detonate. These unstable explosive devices are left behind during and after conflicts and pose dangers similar to landmines.

For queries or comments about this report, please contact conflict.mapping@cartercenter.org

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Since 2012, The Carter Center's Conflict Resolution Program has endeavored to analyze open-source information related to the Syrian conflict in as much detail as possible, with the goal of assisting mediators and conflict responders with up-to-date, detailed analysis of developments on the ground. Using these publicly available resources, as well as information gleaned from regular consultations with stakeholders, the Center has documented and mapped 155,000 conflict events in Syria, with support from ACLED, as well as the ever-changing relations among armed groups. For more information, visit our [Support for Peace in Syria](#) page on The Carter Center website.

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