



SYRIA DAMAGE ASSESSMENT

*of selected cities
Aleppo, Hama, Idlib*

PHASE III MARCH 2017

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1818 H Street NW
Washington DC 20433
Telephone: 202-473-1000
Internet: www.worldbank.org

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Cover photo:

The East Ansari Neighborhood in Aleppo, highlighting housing damages as of March 2016.
Image Source: Airbus, 10 March 2016.

Disclaimer: This is a remotely conducted exercise relying primarily on data from satellite imagery, social media analytics corroborated and validated by other sources and means including publicly available information. Although all efforts are made to improve accuracy to the extent possible, a remote assessment is broad-brush and produced in a quick timeframe for damage data relevance. It provides an indicative picture of the effect of the conflict on physical infrastructure and the quality of services. ***The damage assessment is not comprehensive of all cities and regions; the presented damages provide partial estimates and the monetary value is expressed in terms of pre-crisis replacement costs.***

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TABLE OF CONTENTS

i	Executive Summary
1	Introduction
4	<i>Methodology</i>
7	Sector Analyses
7	<i>Housing</i>
15	<i>Health</i>
20	<i>Transport</i>
24	<i>Energy</i>
35	<i>Education</i>
39	<i>Water Supply and Sanitation (WASH)</i>
46	<i>Urban Institutions and Service Provision</i>
51	References

LIST OF FIGURES

- iii Figure 1: *City-Level Damage Estimate Range Comparison (in US\$ million), Syria DA Phases 1-3*
- iv Figure 2: *City-Level High Damage Estimates, Syria DA Phases 1-3*
- v Figure 3: *Sector-Level Damage Range Estimates (in US\$ million), Syria Phases 1-3, on Log Scale*
- vi Figure 4: *Breakdown of Aleppo's Damage Estimates by Sector (in percentage), February 2017*
- xii Figure 5: *Total Damage Estimates by City - Comparison December 2014 vs March 2016*
- xii Figure 6: *Percentage share of Total Damages Compared by City - March 2016 Update*
- xiii Figure 7: *Total Damage Estimates by Sector - Comparison December 2014 vs March 2016*
- xiv Figure 8: *Percentage share of Total Damages by Sector - March 2016 Update*
- 8 Figure 9: *Residential Housing Damage in Idlib, Hama and Aleppo*
- 9 Figure 10: *Damage to the Housing Sector as a Percentage of Baseline Value (\$) Destroyed or Damaged*
- 10 Figure 11: *Monetary Percentage of Total Destruction by City*
- 11 Figure 12: *Percentage of Baseline Inventory Destroyed or Damaged*
- 13 Figure 13: *Hama City IDP Settlement Patterns*
- 14 Figure 14: *Idlib Push/Pull Factor Ratings by Neighborhood*
- 15 Figure 15: *Hama-Halted Construction Projects (September 2016)*
- 18 Figure 16: *Damage to Total Health Facilities by City*
- 18 Figure 17: *Damage Across All Five Districts by Facility Type -February 2017 Update*
- 21 Figure 18: *A Side-By-Side Comparison of 1 August 2016 and 1 December 2016 Imagery of a Southern Interchange of Aleppo's Outer Ring Road (located at 36.159, 37.167) Shows an Increase in Blockages Hindering Access into/out of the City from this Point*
- 22 Figure 19: *Roads in the Industrial District of Aleppo Blocked with Debris after a November 2016 Shelling Attack*

- 24 Figure 20: *16 December 2016 Photos from Aleppo. Karm al-Qaterji Main Roads are Passable, but Smaller Roads Still Contained Debris at the Time*
- 25 Figure 21: *Aleppo Power Grid, Pre-Crisis*
- 26 Figure 22: *Aleppo Thermal Power Plant Damage (Exterior)*
- 27 Figure 23: *Aleppo Damage to Power Sector*
- 28 Figure 24: *Hama Damage to Power Sector*
- 29 Figure 25: *Idlib Damage to Power Sector*
- 32 Figure 26: *VIIRS Imagery Comparison of Aleppo City Lighting, January 2014 and July 2016*
- 32 Figure 27: *The Image Below Demonstrates the Resilience of the Local Population Under Active Conflict Conditions. Residents Have Cut and Fixed Barrels on Rooftops as Makeshift Windmills*
- 34 Figure 28: *Idlib City - Access to Public Network Power (September 2016)*
- 35 Figure 29: *VIIRS Imagery Comparison of Idlib City Lighting, January 2014 and July 2016*
- 37 Figure 30: *Idlib - Damage to Education and Health Sectors*
- 39 Figure 31: *Children Without Access to Educational Facilities in Hama City*
- 41 Figure 32: *Bab al-Nayrab Water Pumping Station: Partially Damaged, Partially Functioning*
- 42 Figure 33: *WASH Damage in Aleppo as of February 2017*

LIST OF TABLES

i	Table 1: <i>Scope and Limitations of the Syria Damage Assessment of Selected Cities</i>
ii	Table 2: <i>Comparison of the First, Second and Third Phases</i>
9	Table 3: <i>Cost of Total Damage to Housing Assets (Million USD)</i>
10	Table 4: <i>Total Damage Inventory</i>
10	Table 5: <i>Average Housing Damage Percentage by City – Comparison Dec 2014, Mar 2016, and Feb 2017</i>
18	Table 6: <i>Total Damage Inventory</i>
19	Table 7: <i>Estimated City-Specific Damage Costs in US\$ million in the Health Sector</i>
20	Table 8: <i>Road Transport Sector’s Comparison between Dec. 2014, Mar. 2016, Sep. 2016 and Feb. 2017</i>
22	Table 9: <i>Pre-Crisis Baseline</i>
23	Table 10: <i>Three Cities Rollup-Feb 2017</i>
23	Table 11: <i>Total Three Cities Range, (Monetary)</i>
30	Table 12: <i>Idlib Substation Damage by Substation Capacity</i>
30	Table 13: <i>Consolidated Table for Damage by Facility for Aleppo, Hama and Idlib</i>
31	Table 14: <i>Consolidated Table for Damage Comparison with the Previous Update (March 2016) by Facility for Aleppo, Hama and Idlib</i>
37	Table 15: <i>City-Level Physical Damage Cost Ranges in Education</i>
44	Table 16: <i>Total Damage Inventory</i>
45	Table 17: <i>Dam Damage Inventory</i>
46	Table 18: <i>Water Change Detection Summary</i>

LIST OF BOXES

- 5 **Box 1: Syria DA Guidance: Definition and Calculation of Damage**









ACRONYMS

DA	Damage Assessment
DNA	Damage and Needs Assessment
EU	European Union
GDP	Gross Domestic Product
GER	Gross Enrolment Rate
GNI	Gross National Income
GP	Global Practice
GSURR	Social, Urban, Rural and Resilience Global Practice
ICT	Information and communication technology
IDP	Internally Displaced Person
INGO	International Non-Governmental Organization
IOM	International Organization for Migration
IsDB	Islamic Development Bank
MENA	Middle East and North Africa
MW	Megawatt
NGO	Non-Governmental Organization
OOP	Out-of-pocket
PDNA	Post Disaster Needs Assessment
RPBA	Recovery and Peacebuilding Assessment
SIRI	Syria Information and Research Initiative
SARC	Syrian Arab Red Crescent
UN	United Nations
UNHCR	The UN Refugee Agency
UNICEF	United Nations Children's Fund
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization

EXECUTIVE SUMMARY

The objective of the Damage Assessment (DA) of selected cities is to provide information on the effects of the current crisis on population, physical infrastructure, and quality of service delivery in those cities. It is a broad brush and remote-based exercise, drawing mostly on existing secondary sources of information including satellite imagery, social media analytics, existing public information, and – whenever available – partner organizations' data. The assessment data is aggregated in a digital geospatial platform that allows for the collection, monitoring and regular updates of the damage information. Table 1 summarizes the scope and limitations of the DA.

Table 1: Scope and Limitations of the Syria Damage Assessment of Selected Cities

Damage Assessment is ✓	Damage Assessment is NOT ✗
 <p>A broad-brush and remote-based methodology utilizing a mix of inventory (facility level) and percentage based assessment depending on assets and sectors.</p>	 <p>A detailed and ground-based assessment.</p>
 <p>An assessment of damages.</p>	 <p>A needs, loss and macroeconomic impact assessment.</p>
 <p>Based on some primary (satellite imagery) and mainly secondary data sources.</p>	 <p>Mainly based on primary data sources.</p>
 <p>Damage assessment for 6 cities (phases 1 & 2) with an update for 3 cities (the current phase 3). 6 sectors with soft and infrastructure damages.</p>	 <p>Countrywide assessment. Social, economic, institutional, governance, etc., analyses.</p>

At present, more than 13.5 million Syrians are in need of humanitarian assistance, including 4.6 million people trapped in besieged and hard-to-reach areas.¹ Out of a pre-conflict population of over 20 million², 11.1 million people have been forcibly displaced within Syria and across its borders (4.8 million are registered as refugees, and 6.3 million are internally displaced).³ Many more within the country have been impacted by violence, shortages of food and medical care, and population flows. The findings of this assessment illustrate the variety of challenges that physical damage and the deterioration of service delivery present, as well as new demographic factors resulting from seismic shifts in the settlement patterns of conflict-affected populations within the country.

This assessment has been conducted at three distinct times during the evolution of the crisis. Phase 1 was conducted in December 2014, Phase 2 in March 2016, and Phase 3 in February 2017. The first phase of the assessment established pre-crisis baseline data on assets and facilities, and estimated damages across six cities and six sectors as of December 2014. The second phase was an update of the December 2014 assessment, and provided a more recent snapshot of damages and quality of services as of March 2016 by using the baseline established in the first phase. The third phase updates the damage information of the second phase for three cities: Aleppo, Idlib and Hama.⁴

Comparison of the three phases helps to provide emerging trends of deterioration or improvement of services. By comparing updated information from October 2016 to the March 2016 and December 2014 assessments, the third phase can detect the change in damage and quality of services over more than two years. Table 2 compares the scope of the three phases.

Table 2: Comparison of the First, Second and Third Phases

	First Phase	Second Phase	Third Phase
Assessment Date	December 2014	March 2016	October 2016 <i>Aleppo assessment Updated to February 2017</i>
Scope	Damage and quality of service delivery	Damage and quality of service delivery	Damage and quality of service delivery
Geographic Coverage	6 cities (Aleppo, Dar'a, Hama, Homs, Idlib and Latakia)	6 cities (Aleppo, Dar'a, Hama, Homs, Idlib and Latakia)	3 cities (Aleppo, Idlib, Hama)
Sectoral Coverage	7 sectors (education, health, water and sanitation, energy, transportation, housing and agriculture)	6 sectors (education, health, water and sanitation, energy, transportation, and housing)	6 sectors (education, health, water and sanitation, energy, transportation, and housing)

1 UN OCHA, Syria Country Profile.

2 WDI, UN Population Data.

3 IOM, Syria Crisis Appeal 2017.

4 Some limited information is provided on Homs based on information from a partner assessment.

Choice of Cities and Rationale

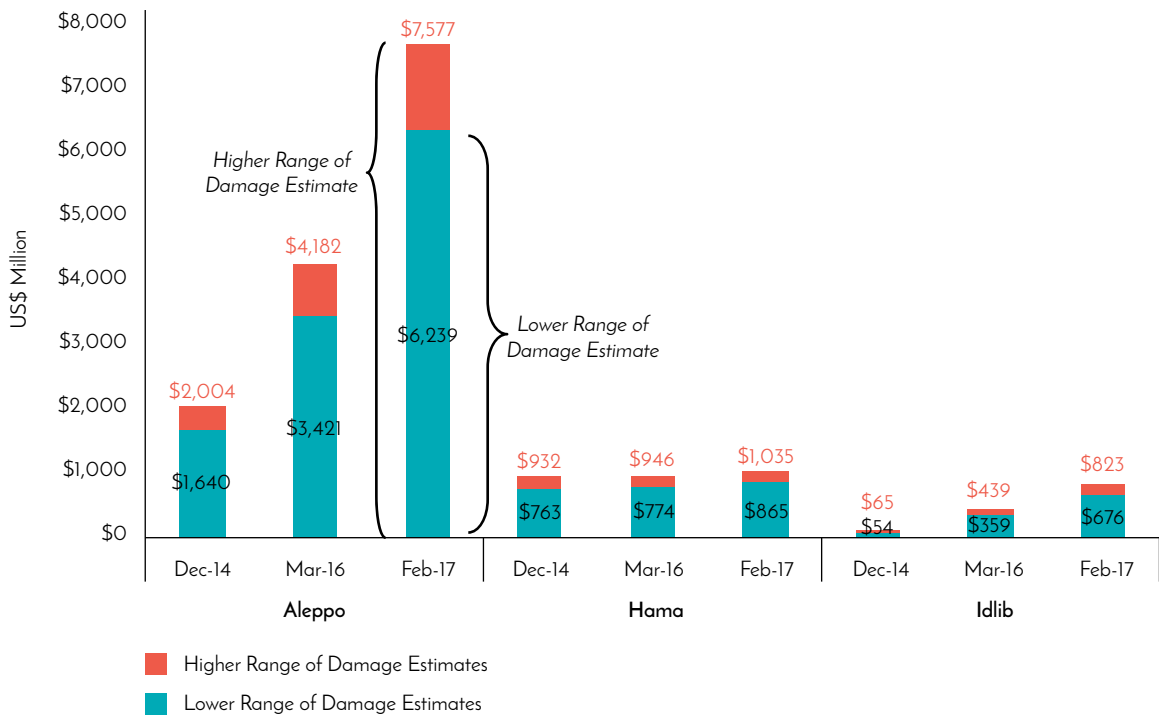
The choice of cities was based on large population size and one or more of the following criteria: (1) significant infrastructure damage; (2) loss of basic services (food, water, electricity); and/or (3) exodus/influx of large groups of internally displaced people (IDPs). The rationale behind choosing to update Aleppo, Idlib and Hama in phase 3, lies in the three very different scenarios that they provide; Hama city, under the authority of the Syrian government, sustained damage prior to the time of study, and because of its relative security and intensified conflict in surrounding regions, has experienced a significant influx of IDPs. Idlib, under control of opposition forces, experienced continuing shelling and inter-neighborhood population movement. Aleppo was divided between its east and west parts and experienced significant damage. Comparing the three scenarios provides unique insight that can be applied to perform analysis and estimations in different cities with similar dynamics.

PHASE 3 FINDINGS

Damage by City

As of February 2017, total damage estimates for the three cities covered in this phase (Aleppo, Idlib and Hama) were estimated to range between US\$7.8 and US\$9.4 billion. This represents an approximate increase of 70 percent since March 2016 (second phase) and 215 percent since December 2014 (first phase) for the three cities (see Figure 1).

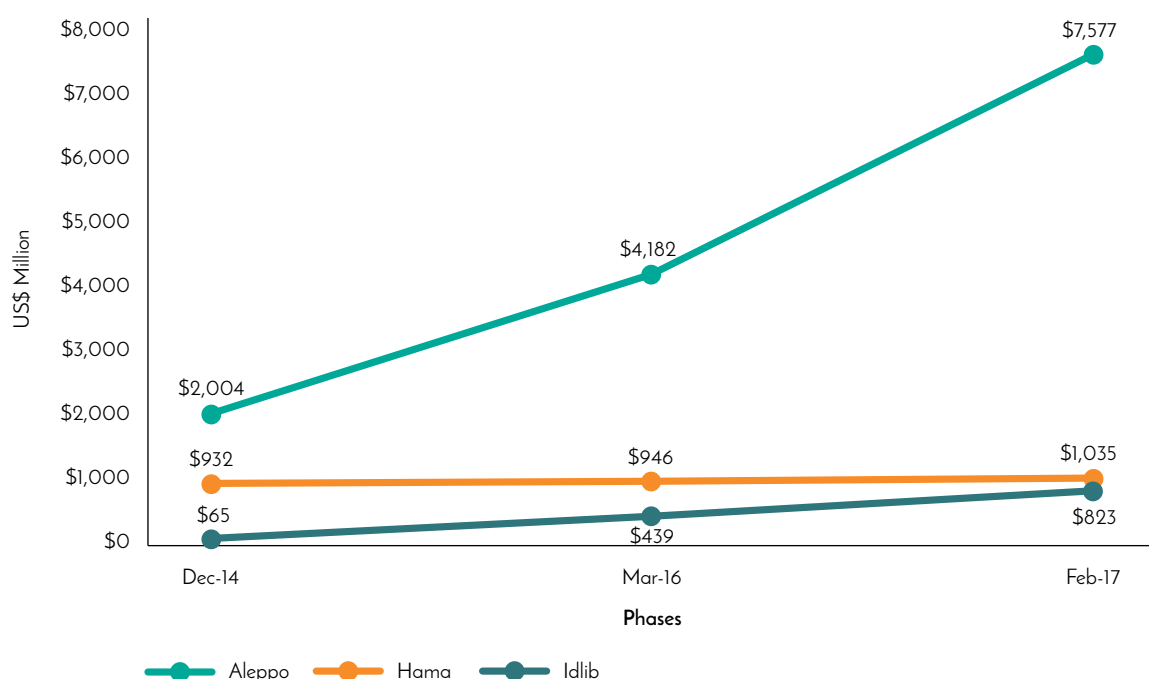
Figure 1: City-Level Damage Estimate Range Comparison (in US\$ million), Syria DA Phases 1–3



Of the three cities, Aleppo is by far the most affected, accounting for roughly 80 percent of the total estimated damages as of February 2017. Total damage estimates for Aleppo have doubled since March 2016 and tripled since December 2014. This is primarily due to a considerable increase in housing sector damage ranging from US\$1.6-2.0 billion in December 2014 to US\$3.4-4.2 billion in March 2016 to US\$6.2-7.6 billion in February 2017 (see Figure 1).

Although to a much lesser extent, damages have also increased in the other two cities, particularly in Idlib. Damages are estimated to range between US\$865-1,035 million for Hama and US\$676-823 million for Idlib as of February 2017. While damages in Idlib increased between March 2016 and February 2017 by 87 percent, damages in Hama increased by a more modest 9 percent. (See Figure 2).

Figure 2: City-Level High Damage Estimates, Syria DA Phases 1-3

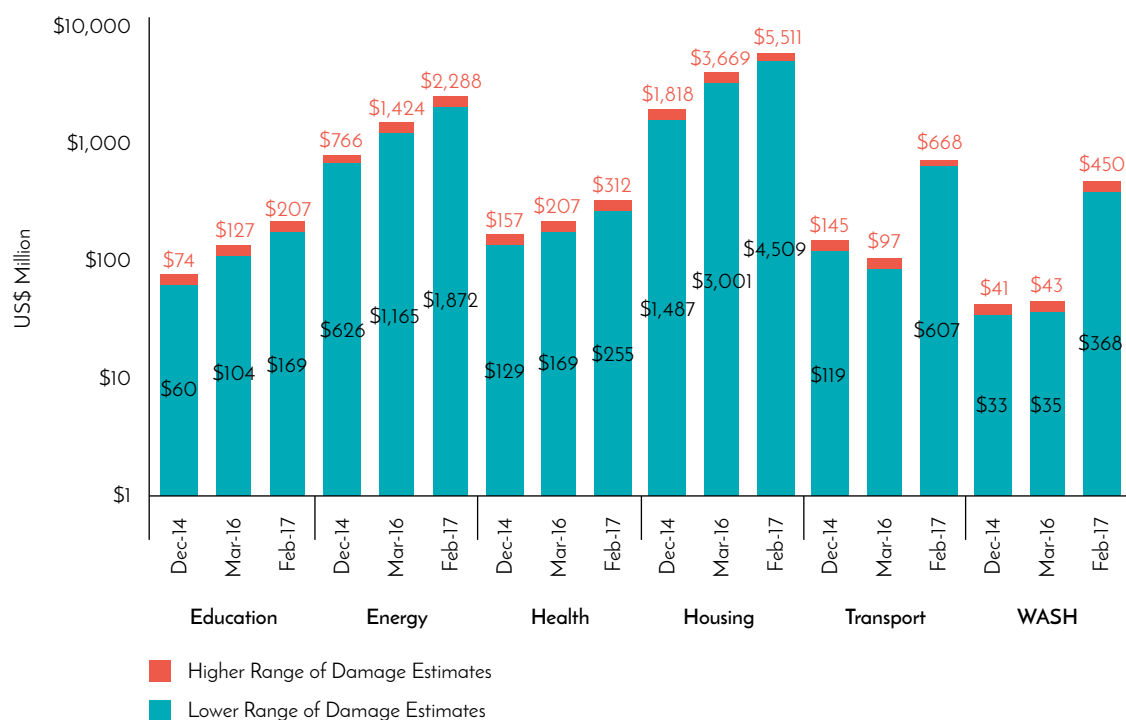


Damage by Sector

As of February 2017, the sector with the highest estimated damages in the three cities is by far housing (US\$4.5-5.5 billion), followed by energy (US\$1.8-2.3 billion). Estimated damages increased in all sectors between March 2016 and February 2017, with damages in the WASH sector increasing more than ten times and damages in the transport sector increasing nearly seven-fold (Figure 3). These increases are mainly due to utilizing an improved methodology for considering damages in the transport and WASH sectors.⁵

⁵ Transport sector damage cost has increased by 7 fold. This is due to utilizing an improved methodology that took into consideration collateral damage beyond the road section that was directly damaged. While damage to WASH sector has increased by 10 fold from the last assessment, this is mainly due to updated information on damages to WASH facilities that were not incorporated into earlier assessments.

Figure 3: Sector-Level Damage Range Estimates (in US\$ million), Syria Phases 1-3, on Log Scale



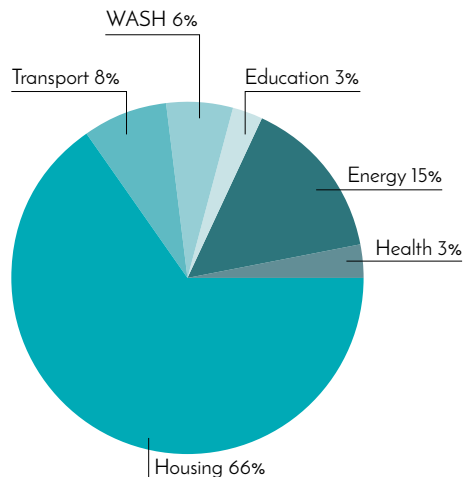
As stated above, the highest damage estimate value can be attributed to the housing sector, which received considerable amounts of damage and destruction. Damage estimates in the housing sector increased from US\$1.5-1.8 billion in December 2014 to US\$3.0-3.7 billion in March 2016, and US\$4.5-5.5 billion in February 2017. This equals a more than 200 percent damage estimate increase over the entire assessment period of more than two years (Figure 3).

Damage estimates in the housing sector are highest in Aleppo, where more than 65 percent of total damage is attributable to housing (Figure 4). Indeed, the sheer size of damages in the housing sector (US\$4.5-5.5 billion) dwarfs that of other sectors, which still have seen considerable damage. For example, damages in the energy sector in Aleppo are estimated to range between US\$1.9 -2.3 billion.

Push-pull Factors in Population Mobility

Significant population mobility can be seen at the intra-city level, where people are moving from one neighborhood to another driven by a variety of pull and push factors. Factors include security, stability and average rent levels. Also significant are the local cost of food supplies, water access, garbage removal availability, household connection to sewage, and power access. For instance, Al-saha at-tahtaniyya neighborhood in north central Idlib city is one of the most attractive destinations to incoming IDPs because of the area's relative stability and security, good water access and low rent costs. Conversely, Al-dabit neighborhood in western Idlib may be the least desirable IDP settlement location due to its relatively poor security environment, high rents and a lack of access to water.

Figure 4: Breakdown of Aleppo's Damage Estimates by Sector (in percentage), February 2017



Overview of the Methodology

The Syria Damage Assessment provides a broad-brush estimate of the effect of the conflict on both infrastructure and service delivery.

This DA was envisioned as a rapid exercise relying **primarily on a remote-based assessment methodology**. Since primary data gathering is generally impossible in an ongoing conflict given the challenging security conditions, the DA draws mostly on secondary sources of information such as high resolution satellite imagery, (social) media analytics, data mining and existing public information. Whenever possible, the analysis relies on direct damage data based on partners' assessments.

As a first step of the first phase, asset baseline information for each sector was developed at the district level. Damage information from the different sources was then assessed against the baseline in each of the three phases. Based on the reported damage level, each asset was assigned a **physical damage status** based on three classifications: no damage, partial damage (less than 40 percent of the asset is damaged) and complete destruction (more than 40 percent of the asset is damaged or the damage is structural).⁶ Whenever possible, the DA also assessed the **operational status of facilities** (functional or non-functional) to determine the level and quality of service delivery across the different sectors. This analysis was based on the facilities' physical status (based primarily on satellite imagery) as well as qualitative data derived from social media, news reports, and partner assessments.⁷

For the damage estimation, the average damage value was calculated based on the number of damaged facilities, their physical status (partially damaged or destroyed), and the estimated pre-crisis unit cost associated with each asset class. In line with standard DA methodology, destroyed assets were costed at 100 percent of the unit cost and partially damaged assets at 40 percent. The largely remote nature of the assessment and the uncertainties around the unit

⁶ This classification is in line with the standard Post Disaster Needs Assessment (PDNA) methodology.

⁷ For those assets where visual inference could not be made, a proxy estimation is used. E.g. if 50% of a building stock in a specific area is partially damaged, it is assumed that 50% of assets in a different sector are also partially damaged.

replacement cost estimates mandated the provision of a **damage range** for each sector. The low and high damage estimates were calculated with a margin of the average damage cost that varied from sector to sector depending on the level of confidence.

SUMMARIES OF SECTOR REPORTS

1. Housing

The damage assessment for the housing sector covers the following asset classes: **Apartment Building, Popular Housing (Sha'bi), Villa, Traditional Arab Home (Dar'arabi), and Country House.** The assessment only covers physical damage to the core housing structures. It does not include the destruction of amenities inside the house, and losses resulting from looting. With around 58 percent of the total damage estimates, the housing sector is the most affected sector assessed in this DA.

Syria's forced displacement crisis has a significant impact on the housing sector. Large numbers of internally displaced persons have settled in cities and are driving rapid urbanization – the country's urbanization rate has increased from 55 percent to around 80 percent over the last five years. The number of displaced seeking housing has created a huge housing demand while the damage to the existing stock has reduced housing supply. Housing damage across Aleppo, Idlib and Hama is significant. Up to February 2017, around 28 percent of the housing units assessed had been damaged (7 percent destroyed and 21 percent partially damaged). Compared to the March 2016 assessment in the three cities, there was an additional 9 percent increase in damage to the overall pre-conflict housing stock by the current (3rd) phase of this report. Looking at each city individually, Aleppo and Idlib experienced similar effects on their housing assets with around 32 percent of their original housing stock damaged, compared to 6 percent in Hama. However, the monetary value of destruction in Aleppo city has exceeded that of Idlib due to the large size of Aleppo's original housing stock; Aleppo alone is estimated to bear 91 percent of damage estimates of the three cities, Idlib stands at 6 percent while Hama at 3 percent.

Total damages to the housing sector across the cities of Aleppo, Hama and Idlib are estimated to range between US\$4,509 million and US\$5,511 million.

Population Movement

The population of the three examined cities has fluctuated between growth and shrinkage. Hama like the other cities has witnessed outward migration at some point. However, the limited fighting experienced by this urban center relative to the rest of Syria, coupled with instability in surrounding areas has precipitated a significant trend of inward migration and settlement in Hama. Idlib experienced a population peak around May 2016 due to IDP inflows followed by an outward migration trend between early June and August 2016 due to significant intensification of aerial bombardment. The city has also experienced an intra-city migration based on multiple identified pull and push factors between neighborhoods — primarily: security, safety, and affordability. Recently, Aleppo experienced similar population trends. Following the intensified conflict at the end of 2016, a huge number of people fled Eastern Aleppo; around 121,350 people from Eastern Aleppo were registered as displaced as of 20 January 2017. Most displaced reportedly chose to stay close to their place of origin so they can return after cessation of hostilities. The urban footprint is affected by the conflict and population movement, as is visible through halted construction projects or new settlements at the outskirts of the studied cities.

2. Education

Impediments to accessing schools still exist for both teachers and students as schools continue to be targeted and attacked, causing teachers and students to fear for their physical wellbeing. Safety concerns and limited education services led to an estimated 44 percent student drop out in enrolment between 2010/11 and 2014/15⁸ and estimated current gross enrolment rates (GERs) of 78 percent, which are significantly lower than the earliest estimates of GER in Syria of 91 percent in 1996.⁹ Estimates indicate that 53 percent of education facilities in the city of Aleppo are either partially damaged or fully destroyed. Despite some infrastructure damage, all education facilities are functioning in Hama, while in Idlib and Aleppo about 92 percent and 39 percent education facilities are still functioning, respectively. Facilities listed as non-functional may have sustained significant infrastructure damages, or may be cut off from a sufficient supply of clean water and power sources, thus rendering the facility unfit for use. Despite the high levels of physical damage to education facilities, schools continue to function with limited capacity. Where possible, schools are adjusting their capacity to offer services by reducing instructional hours, accepting higher rates of students, and allowing teachers with less qualifications to teach. These basic services make it possible for schools to operate at a minimal capacity and offer students a venue for receiving education services, but at a lower quality given the constraints to service delivery.

Total damages to education facilities across the cities of Aleppo, Hama and Idlib are estimated to range between US\$ 169 million and US\$ 207 million.

3. Water Supply and Sanitation (WASH)

The WASH sector has experienced significant damage. Of a total of 327 WASH assets in the cities of Aleppo, Hama, Homs and Idlib around 60 percent (predominantly water towers) have suffered damage, mainly in Aleppo. Although much of the rest of the infrastructure has been undamaged, reduced functionality is a significant problem for all the assessed cities. In addition, the 6-year-long crisis has crippled the electricity sector which in turn has greatly impacted water services due to the central role electricity plays in pumping water. Alternative service providers have sprung up to fill gaps in service delivery, providing expensive (>US\$10 per m³) tankered water of unregulated quality. No residents in Aleppo have had access to water via the public network since January 2017. Residents are entirely reliant on the more than 150 public and 300 private wells within the city for their water supply. In addition, population shifts due to the influx of internally displaced persons in relatively conflict free areas such as Hama and Idlib have placed added stress on public infrastructure.

Total damages to WASH facilities across the cities of Aleppo, Hama and Idlib are estimated to range between US\$ 368 million and US\$ 450 million.

4. Transport

Transportation is particularly important as it affects access to services necessary for sustaining livelihoods as well as affecting service delivery in other sectors. Furthermore, road conditions directly impact the prospects of refugees and IDPs returning to their homes. As of February 2017, approximately 28 percent of the total intra-city road lengths in the three cities had been directly or indirectly impacted by the conflict. The impact on road functionality extends far beyond direct road damage. Large segments of roads are often rendered inaccessible due

8 UNICEF. (2015). *Syria education sector analysis: The effects of the crisis on education in areas controlled by opposition groups, 2010–2015*.

9 Humanitarian Response Plan; January– December 2016. (2016). Syrian Arab Republic.

to direct damage to short segments, which has more substantial impact on overall mobility. Primary roads and trunk roads have experienced the most damage with around 30 percent of their respective total lengths damaged. Aleppo continues to be the most impacted city, accounting for the majority of the damage in the three cities. In Aleppo, 44 percent of the inner-city road network has been damaged. Approximately 25 percent of bridges are impassable, and 65 percent of roads are in need of basic repairs due to lack of maintenance.

Total damages to transportation across the cities of Aleppo, Hama and Idlib are estimated to range between US\$608 million and US\$668 million.

5. Health

There is evidence of significant damage to the health system. In terms of physical damage to infrastructure, more than half of all hospitals in the assessed cities have experienced some form of damage (completely destroyed or partially damaged) as of February 2017. At least 80 percent of health facilities in Idlib and 60 percent of health facilities in Aleppo were completely destroyed or partially damaged as of February 2017, with serious implications for their capacity to treat the increasing burden of disease and injuries, including complications from untreated non-communicable diseases. The damage to health services has been even more severe in certain localities, with nearly all health facilities in Eastern Aleppo reported damaged or destroyed during the recent fighting. Apart from direct hits to infrastructure, the instability due to the conflict has led to provider flight and a shortage of trained medical personnel to deal with the increasing medical need. In addition, functioning medical equipment and medicines are in short supply with accounts of medical aid convoys being blocked. As a result, the health situation has further deteriorated with an increase in illness and deaths due to complications from untreated non-communicable diseases; reemergence of communicable diseases such as polio, measles and leishmaniasis; increasing prevalence of malnutrition; and exacerbation of mental health conditions such as post-traumatic stress disorder and "toxic stress," especially in children.

Total damages to health facilities across the cities of Aleppo, Hama and Idlib are estimated to range between US\$255 million and US\$312 million.

6. Energy

The assessment captured the extent of damage to the power sector in the cities of Aleppo, Hama and Idlib. As of February 2017, the Aleppo Thermal Power Plant, which provided electricity to 60 percent of the city, had been categorized as fully destroyed as a result of significant damage sustained in the previous few months. Of a total of 16 substations in Aleppo, (transmission and distribution of varying capacities) one has been completely destroyed while 10 have been partially damaged. Idlib energy infrastructure is comprised of one power generation plant and four power transfer stations. The power plant sustained substantial damage as a result of nearby fighting, looting, and the dismantling of the facility's metal equipment and auxiliary installations to be sold as scrap metal. It has been designated as 'destroyed' due to its non-operational status. As of September 2016, two of the main power plants in Hama had sustained significant damage as a result of nearby conflict. Additionally, natural gas, diesel, and heavy fuel oil shortages have prevented the facilities from operating at full capacity.

Total damages to energy facilities across the cities of Aleppo, Hama, and Idlib are estimated to range between US\$1,872 million and US\$2,288 million.

7. Urban Institutions and Service Provision

The three examined cities provide three different contexts regarding whether they are government- or opposition-controlled and what institutions are put in place. Areas under government control have been functioning with roughly the same pre-crisis public institutions while areas under opposition control in Aleppo and Idlib have seen the emergence of local councils to take charge of service provision. The difference between government controlled and opposition controlled areas has been in both the level and approach of service provision. For example, government-controlled areas are characterized by a centralized public sector while areas under opposition control have been marked by decentralization, with a variety of public, private and CSO service providers.

In both government and opposition-controlled areas, there have been efforts toward repair and recovery. Yet providing services in the three cities raises two kinds of challenges. The first stems from conflict-induced damage. The second is related to the additional pressure on services due to population movement. Still, signs of resilience can be seen. In Aleppo, for example, limited supplies of electricity are being provided by construction of alternative power sources, such as small-scale devices harnessing the energy of wind and solar power. In general, schools continue to function, with a huge decrease in capacity, attendance rates and hours per day to make room for multiple shifts. Health services to those in areas under government control have taken place through the city's remaining medical facilities; while those residing in opposition-held areas have had comparatively limited access to temporary health points, mobile clinics, and/or a few repaired health facilities.

PHASE 2 FINDINGS

Whereas Phase 3 focuses on updating the situation of the three cities, Phase 2 (March 2016) provided an overview of updates for six cities namely Aleppo, Dar'a, Hama, Homs, Idlib and Latakia, assessing damage and the quality of service delivery. The following section presents a brief summary of those findings for comparison.

As of March 2016, total damages (across all examined sectors) for the six cities were estimated to range between US\$5,920 million to US\$7,236 million.¹⁰ This represents an approximate increase of 62 percent over December 2014, when estimated damages ranged between US\$3,654 million and US\$4,466 million.

Aleppo remained the most affected city, accounting for roughly 58 percent of the total estimated damages. By March 2016, total damage estimates for Aleppo had increased by 109 percent over December 2014, primarily due to a considerable increase in housing damage.¹¹ Despite the high damage estimates, there was a substantial amount of resiliency, particularly in Aleppo's health and education sectors. Although the conflict had severely impacted physical infrastructure and service delivery capabilities for these sectors in eastern Aleppo, informal health facilities and schools were emerging in alternate locations and continued to offer healthcare and education to local populations. In addition, an alternative water supply network, consisting mainly of wells that had not been used as sources of drinking water prior to the conflict, had expanded throughout the city. However, Aleppo's population had gone through long periods without access to electricity or piped water from summer 2015. While public access to electricity had started to be restored both in government- and opposition-controlled areas, most residents and facilities such as hospitals appeared to rely on private generators.

¹⁰ The estimated damage estimate range was calculated with a 10 percent margin of the median damage estimate.

¹¹ In December 2014, Aleppo accounted for roughly 40% of the damages.

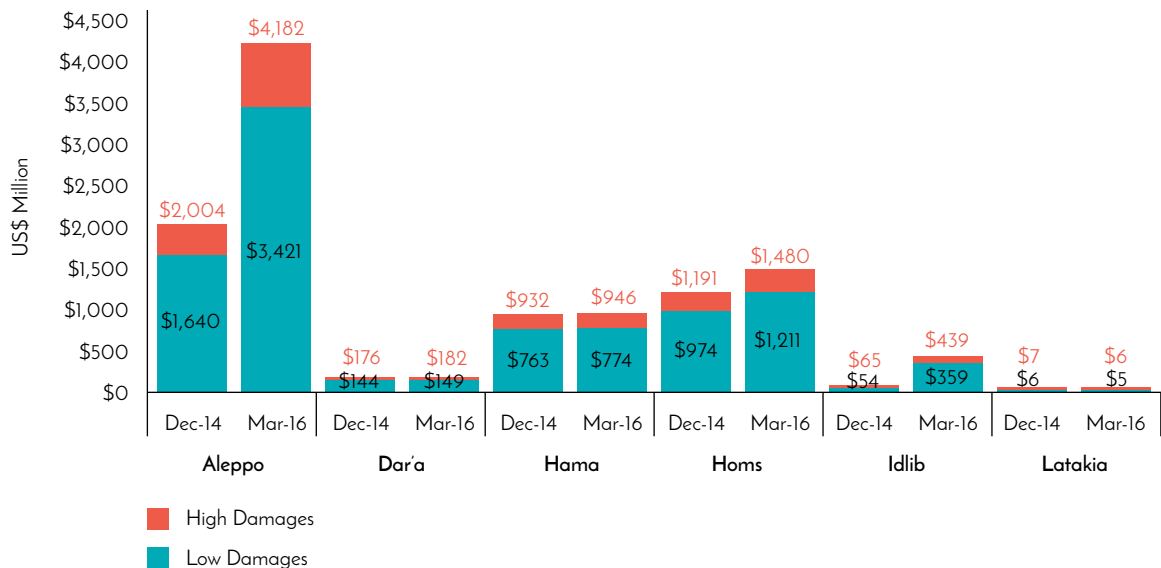
Following Aleppo, Homs and Hama were the most affected cities. Overall, they account for 21 percent and 13 percent of the total estimated damages, respectively. Housing was the most affected sector in Homs accounting for almost 83 percent of the damage estimates. A number of schools reopened for the spring 2016 semester after being closed for a few years due to siege conditions and conflict. The majority of reopened schools were likely located in the less affected areas of the western and southern parts of the city. Although some healthcare facilities in the city had been partially damaged, the majority of hospitals in Homs had resumed functioning as of early 2016. In addition, many areas in the city continued to experience inconsistent access to the public electricity network, although the governorate's main power plants were operational. The conflict also had a profound impact on the availability of water via the public network in Homs due to direct damage to water lines and frequent power outages that shut down water pumping stations.

Almost 80 percent of the damage in Hama was in the energy sector. The city's energy sector had faced a number of problems affecting functionality and public access to electricity, including power rationing, the collapse of high voltage electricity towers, and technical failures impacting various parts of the local power grid. The health sector, despite sustaining very little damage, had experienced significant challenges including the overcrowding of healthcare facilities, shortages of vital drugs, and the outward migration of medical personnel. Hama's water and sanitation sector had suffered from outdated solid waste disposal systems that had caused sewers to overflow. The poor drainage had led to flooding in some neighborhoods, and there were reports of illegal diversion of water from the public network in certain parts of the city. Finally, Hama's transport sector and the mobility of its citizens had been significantly impacted by the establishment of checkpoints throughout the city. Dar'a and Idlib's share in overall estimated damages is low, partly due to their smaller size compared to the other cities. Overall, the two cities accounted for 2 percent and 6 percent of the total estimated damages respectively. Remarkably though, damage estimates in Idlib increased more than six-fold after December 2014, mainly due to increased damage to the housing and energy sectors. Idlib's health sector also suffered from high damage levels with only two functioning hospitals remaining as of March 2016 and significant unaddressed medical needs (e.g. prosthetics, orthotic specialists, antenatal care).

Latakia was a relatively secure area since the beginning of the conflict, experiencing only very limited destruction. At the time of the Phase 2 report, the city was hosting an estimated 200,000 internally displaced persons. The majority of the IDPs had come to Latakia from the high conflict areas of Idlib and Aleppo. The rapid increase in population put strains on the infrastructure, resources, and social fabric of the city. It seems there were attempts to increase the city's capacity to absorb large numbers of IDPs. Imagery-derived findings showed new residential units that had been constructed or were under construction in the city since 2011 with an estimated capacity to house approximately 120,000 people.

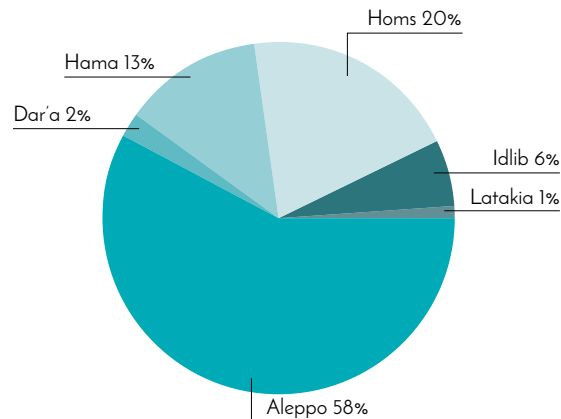
Figure 5 below summarizes the changes in damage estimates between December 2014 and March 2016 for all six cities.

Figure 5: Total Damage Estimates by City – Comparison December 2014 vs March 2016



The share of each city in the overall estimated damages is shown in Figure 6 below.

Figure 6: Percentage share of Total Damages Compared by City – March 2016 Update

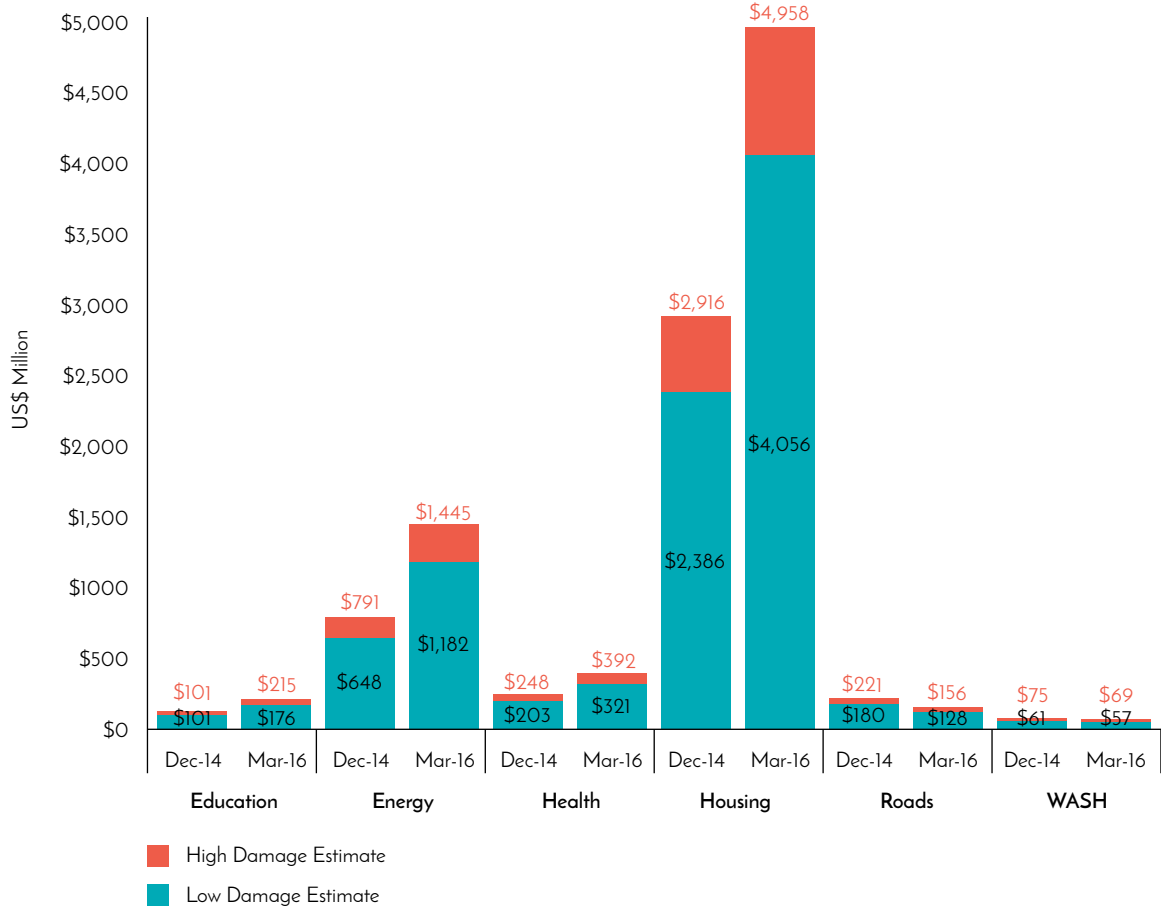


Damage Quantification Ranges by Sectors – Phase 2

Overall damages across the sectors increased between the December 2014 assessment and the March 2016 update (see Figure 7). The sectors with the highest damage estimate increase were housing and energy. Remarkably, the transport sector witnessed a decrease in estimated damages over the 15 month period, attributed primarily to rubble removal and patching of previously unusable roads.¹²

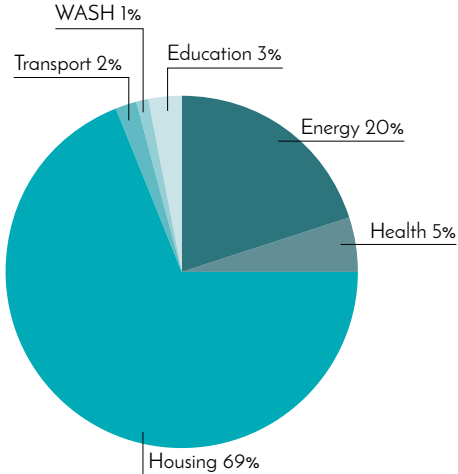
¹² Damage estimates in the water and sanitation sector also decreased between the two assessments, but the change still falls within the margin of error of the assessment methodology.

Figure 7: Total Damage Estimates by Sector – Comparison December 2014 vs March 2016



Housing was by far the most affected sector (see Figure 8), accounting for 68 percent of the total estimated damages across all sectors in March 2016 (65 percent in December 2014). The energy sector represented nearly 20 percent of total estimated damages. Finally, the health sector accounted for more than 5 percent of the total estimated damages.

Figure 8: Percentage share of Total Damages by Sector – March 2016 Update



INTRODUCTION

Project Context and Background

The Syria Damage Assessment (DA) was launched as part of the Syria Information and Research Initiative (SIRI) of the World Bank Group. It is designed to power the relief effort with more and better information and analysis, and constitutes a key analytical work to enhance our situational awareness.

Objective of the Damage Assessment (DA)

The key objective of the DA is to provide information about the effects of the current crisis on the population, physical infrastructure, and the quality of service delivery for the cities of Aleppo, Idlib and Hama. The assessment data is aggregated in digital geospatial platforms that allow for the collection, monitoring and regular updating of damage information.

Since the DA is conducted during an ongoing conflict, it is not a comprehensive evaluation founded on detailed, ground-based data as would be the case for a Recovery and Peacebuilding Assessment (RPBA). It covers neither economic losses nor the macroeconomic impact of the Syrian crisis.¹³ Instead, it provides a preliminary assessment and quantification of physical damage of key infrastructure for three urban centers (the earlier two phases of the DA looked at six cities) across six sectors based on historical replacement costs (see Table 1 in the Executive Summary). Damage estimates are based on pre-crisis unit replacement costs and are therefore backward-looking.

The first phase of the DA, conducted in December 2014, assessed the impacts of the ongoing crisis in Syria on key infrastructure, physical assets and service delivery across key sectors. It covered the following six governorate capitals: Aleppo, Dar'a, Hama, Homs, Idlib and Latakia. Seven sectors were assessed: education, health, water and sanitation, energy, transportation, housing and agriculture. The damage assessment for the agriculture sector covered the whole governorate, while damage assessments for other sectors were targeted at the city-level. Across the different sectors and cities, the assessment established pre-crisis baseline data of assets and facilities, which was then compared to damage information collected through satellite imagery and social media analytics. It also took an initial look at needs in Aleppo, Homs and Dar'a, analyzing how factors such as security, shelter, infrastructure damage, status of services, livelihoods, availability of food, and affiliation factors drive population movements and contextualize decisions to return to areas of origin or other locations.

¹³ See World Bank Economic and Social Impact Assessment, June 2017.

The second phase of the DA was an update of the December 2014 assessment, and provided a snapshot of damages and quality of services as of March 2016. Using the same pre-crisis baselines established in the first phase, the update covered six sectors (education, health, water and sanitation, energy, transportation and housing)¹⁴ and six cities (Aleppo, Dar'a, Hama, Homs, Idlib and Latakia). By comparing updated information from March 2016 to the December 2014 assessment, the second phase was able to detect the change in damage and quality of services during this 15-month period. It therefore helped suggest in which cities and sectors damage levels and the status of service delivery had improved or deteriorated between the two phases in order to establish emerging trends. The second phase did not cover the agriculture sector nor provide an update to the first-phase needs assessment. The third and current phase updates the damage information of the second phase.¹⁵

Choice of Cities and Rationale

The previous phases of the DA covered the following six cities: Dar'a, Aleppo, Homs, Idlib, Hama, and Latakia. These cities are large urban settlements - in terms of population - and were chosen based on one or more of the following criteria: (1) significant infrastructure damage; (2) loss of basic resources (food, water, electricity); and/or (3) exodus/influx of large groups of refugees. Additionally, the rationale behind choosing the three cities for this third assessment, Aleppo, Idlib and Hama, lies in the three very different scenarios that they provide. Hama city was completely under the authority of the Syrian government and had sustained damage prior to the time of study. Furthermore, because of its relative security and the intensified conflict in surrounding regions, it has experienced a significant influx of IDPs. Idlib was completely under opposition forces control and was experiencing ongoing shelling with an inter-neighborhood population movement. Aleppo was divided between east and west; the East area under the control of opposition forces and the West area under Government control. Subsequently, Government forces gained control of the East area and the assessment was updated to capture the resulting impact. Comparing and contrasting the three scenarios provides a unique insight that can be applied to perform analysis and estimations in different cities with similar dynamics.

Key Challenges of the Assessment

Data fragmentation and confidentiality

While information about the impact of the conflict inside and outside Syria exists, its use is limited for two key reasons: the information is fragmented (e.g., by sectors, but not always representative), and critical data is often confidential (agencies have data they are so far not able to share). Fragmentation across sectors, time, and countries prevents data from being comparable. This thwarts the identification of duplicate resources while simultaneously leaving information gaps. It also prevents policymakers from aligning resources to their most effective use (since a comprehensive evaluation and assessment based on detailed data is not available).

Lack of Baseline Information

Absence of baseline information at the city level is another challenge. Most of the humanitarian actors on the ground report damages to facilities (not in the perspective of baseline information). This limits the ability to conduct a systematic assessment of the effect of conflict on the sectors and services. The DA has focused on closing this gap by reporting damages vis-a-vis a comprehensive baseline for each sector that was developed as part of this assessment.

¹⁴ Agriculture was not assessed in the March 2016 Update.

¹⁵ Some limited information is provided on Homs based on information stemming from a partner assessment.

Limited Timeframe for Damage Data Relevance

Given the dynamic situation of an ongoing conflict, the drastic escalation in some areas could undermine the accuracy of the data and its relevance. **The data may quickly become outdated.**

Data accuracy

This is a remotely conducted exercise which means that the data gathered and the assessment conducted relies mostly on satellite imagery. However, data from satellite imagery has been corroborated and validated by other sources and means, including social media analysis. Although all efforts are made to improve accuracy to the extent possible, a remote assessment is broad-brush and provides only an indicative picture of the impact. Such assessments are useful for understanding the nature and extent of the impact and the broad parameters defining the enabling conditions for return of the displaced population. This can inform preparation of strategies and roadmaps for coordinated interventions.

Damage Assessment Methodology

The Bank is building upon and strengthening its existing partnerships with the EU, UN, and other multilateral and bilateral institutions, as well as INGOs and civil society organizations actively working on the Syrian conflict. Efforts were made to put together an active collaboration platform and working arrangements to jointly make use of inter-agency resources, skills, analysis, and information paving the way for potential joint assessments in the future. However, the partners could share only limited information that was used for validation at the broader level.

Given the dynamic situation on the ground and the ongoing fighting, the challenge was to have a quick, low cost, and replicable assessment. To respond to this need, significant efforts in this assessment went into developing baselines disaggregated at the neighborhood level.

Scope

Temporal Scope: The Syrian crisis started in 2011; therefore, the damages are calculated according to the actual or estimated pre-2011 baseline of the physical assets, established in the December 2014 assessment. In the first phase, damages were assessed as of December 2014; the second phase was conducted in March 2016, and the current and third phase in February 2017.

Geographical Scope: The assessment is conducted for the regional capitals of Aleppo, Hama and Idlib. Within these major cities, the data is disaggregated at the neighborhood level while for the rest of the governorate, the data is disaggregated at the district level.

Sectoral Scope: The assessment is conducted for the following key sectors: housing; education (public and private facilities); health (public and private facilities); water and sanitation (public network); energy (public network); and transportation (excluding rural/unpaved roads). Damages to the agriculture sector were only covered in the December 2014 assessment.

Methodology

The damage assessment is envisioned as a rapid exercise, drawing mostly on existing secondary sources of information. Data sources include remote sensing and satellite imagery; social media analytics; existing public information; and data from partner humanitarian agencies. The objective of the DA methodology is to be replicable and provide a broad-brush estimate of the effect of the conflict on both infrastructure and service delivery.

The core of the exercise is a percentage-based assessment methodology that uses proxy indicators to infer damage data (where damage may not be verified by any sources of information). As a first step, asset baseline information for each sector is developed at the neighborhood level. Satellite imagery (50 CM resolution), social media analytics, and information from partner organizations are used to develop the pre-conflict baseline, and in parallel, assess damage to infrastructure assets.

A source accuracy rating system is established. Each data point is given an accuracy rating tier based on the number of attributes of the information source. Key attributes include (i) Information that has been vetted by reputable organizations; (ii) observable/visual evidence that has been corroborated with imagery or social media analytics; and (iii) veracity or non-bias of the information source. A four-tiered rating system was adopted:

- Tier 1: a source exhibits three or more desirable attributes
- Tier 2: a source exhibits two desirable attributes
- Tier 3: a source exhibits one desirable attribute
- Tier 4: aspects of the information suggest intent to deceive

Satellite imagery, information from partners, or social media analytics provide facility by facility damage information. However, it is not comprehensive, which leaves information on a significant number of assets with a tier 4 rating. For all tier 4 rated assets, percentage based damage data was inferred according to the extent and intensity of conflict and overall building damage at the neighborhood level. Percentage based assessment is applicable only to the health, education, transport, and housing sectors.

The electricity and water sectors are subject to a facility by facility assessment. If no information is available for any of the assets in these sectors, they are classified as "unknown damages" and are not costed in certain cases.

Damage information from the different sources was assessed against the baseline in each of the three phases. Based on the reported damage level, each asset was assigned a physical damage status based on three classifications: no damage, partial damage (less than 40 percent of the asset is damaged) and complete destruction (more than 40 percent of the asset is damaged or the damage is structural).¹⁶

Whenever possible, the DA also assessed the operational status of facilities (functional or non-functional) to determine the level and quality of service delivery across the different sectors. This analysis was based on the facilities' physical status (based primarily on satellite imagery) as well as qualitative data derived from social media, news reports, and partner assessments.

¹⁶ This classification is in line with the standard Post Disaster Needs Assessment (PDNA) methodology.

For the damage cost estimation, the average damage cost was calculated based on the number of damaged facilities, their physical status (partially damaged or destroyed), and the estimated pre-crisis unit cost associated with each asset class. These unit costs were based on primary information or estimated by sector specialists. In line with standard DA methodology, destroyed assets were costed at 100 percent of the unit cost and partially damaged assets at 40 percent. The largely remote nature of the assessment and the uncertainties around the unit replacement cost estimates mandated the provision of a **damage cost range** for each sector. The low and high damage estimates were calculated with a 10 percent margin of the average damage cost. Since damage costs are based on *pre-crisis* unit rates, they are backward-looking.

Low cost and quick replicability is the major advantage of this approach. Once a reliable infrastructure baseline is developed, any subsequent damage updates may be done in a cost effective manner by only updating the information on the extent and intensity of conflict and overall building damages.

Box 1: Syria DA Guidance: Definition and Calculation of Damage

Damage: Complete destruction or partial damage of physical assets existing in the affected area.

- Damage occurs during and immediately after the crisis and is measured in physical units (i.e. square meters of housing, kilometers of roads, etc.)
- Its monetary value is expressed in terms of replacement costs according to prices prevailing just before the crisis (i.e. pre-crisis unit replacement costs). In that sense damage is backward looking
- A unit cost is used to calculate the monetary value of damages
- Completely destroyed assets are costed at 100% of the replacement unit cost while partially damaged assets are calculated at 40% of the replacement unit cost.

SECTOR ANALYSES

HOUSING

A. Damage Assessment

Characterization of Housing Damages

In February 2017, a damage assessment of housing assets was carried out for the three Syrian cities, Aleppo, Idlib and Hama, updating a previous assessment conducted in March 2016. The February update relied on a percentage-based assessment methodology that applied damage estimates at the neighborhood-level to the city's housing stock (baseline). The housing stock was categorized into three states, namely "undamaged", "completely destroyed", and "partially damaged". To assess "partial damage," multiple scenarios assuming uniform destruction (versus a collateral method that tied estimations to neighborhood density) were applied to generate low, medium, and high impact estimations. The assessment is primarily based on satellite imagery, corroborated by social media analytics and publicly available information whenever available. The baseline housing data stems from the 2015 damage assessment. The housing typology remains the same as previous assessments, which covered five housing types: apartment buildings, popular housing (Sha'bi), villas, traditional Arab homes (Dar' Arabi) and country houses.

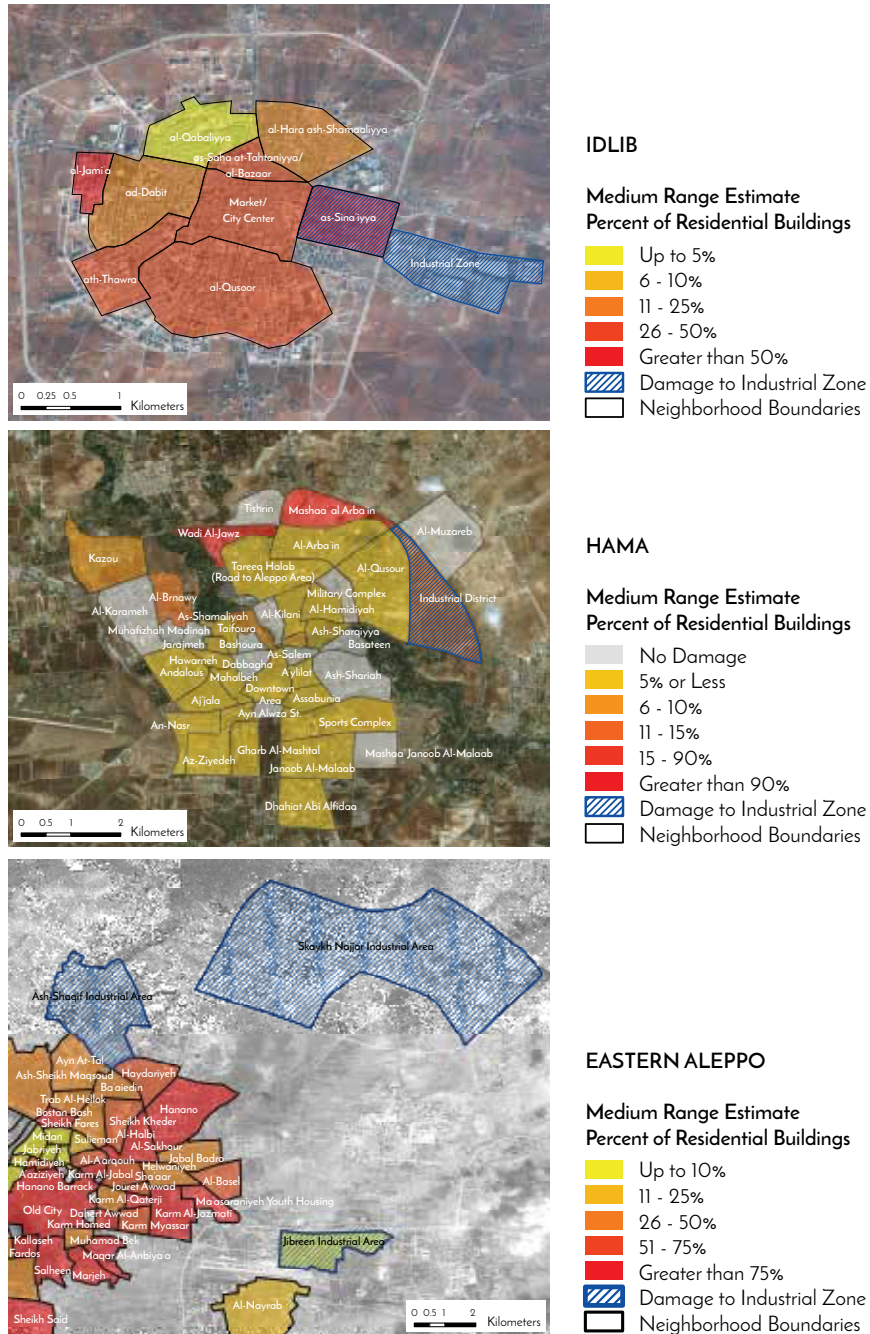
Quantification of Damage to Housing Assets

The overall percentage of damage to buildings can range widely for many of the affected neighborhoods depending on a number of factors including the extent to which damaged structures have been repaired and the presence of ongoing conflict within the area. The number of damaged buildings should be taken as a minimum as the percentage-based assessment methodology is likely to underestimate the overall damage to the housing stock. It is also unclear to what extent subsequent repairs may have been made after the observation period.

Damage to the housing assets is considerable. Overall, and across the three cities, around 28 percent of the housing units assessed have been damaged (7 percent completely destroyed and 21 percent partially damaged). Compared to the March 2016 assessment in the three cities, this represents an additional 9 percent of the pre-conflict housing stock damaged. Looking at each city individually, Aleppo and Idlib experienced similar effects on their housing assets, with

around 32 percent of their original housing stock damaged,¹⁷ compared to 6 percent in Hama. For the three cities, apartments and popular housing make up the bulk of the damaged housing damage (82 percent and 17 percent, respectively).

Figure 9: Residential Housing Damage in Idlib, Hama and Aleppo



17 The housing assets damage percentage measures the damage at the residential unit's level. This should be contrasted to a 44% of residential buildings that are estimated to be damaged.

Figure 10: Damage to the Housing Sector as a Percentage of Baseline Value (\$) Destroyed or Damaged

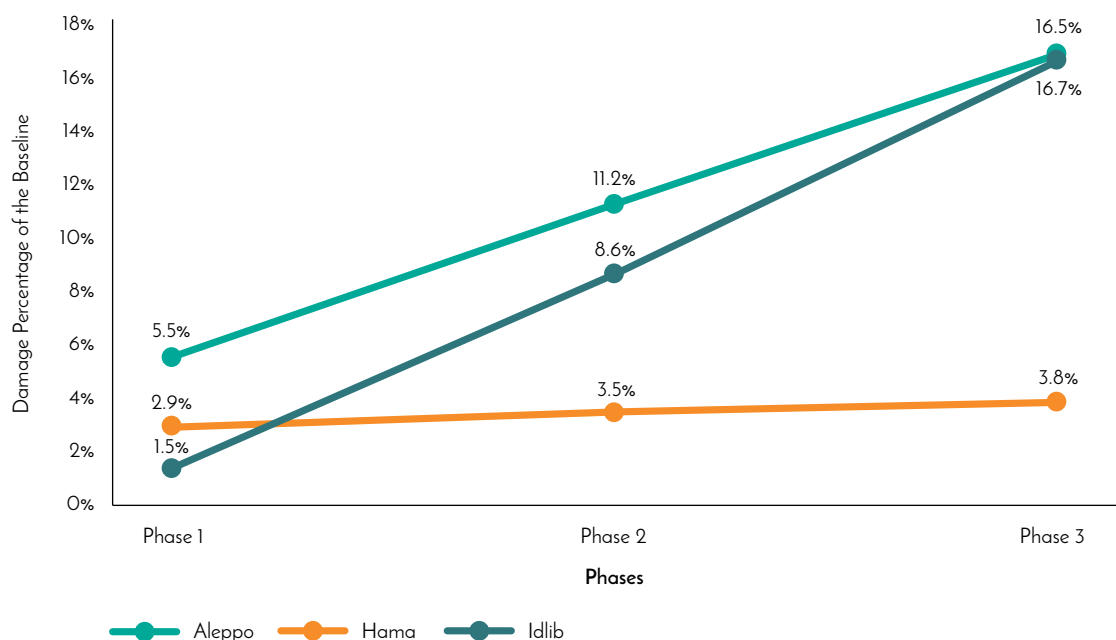


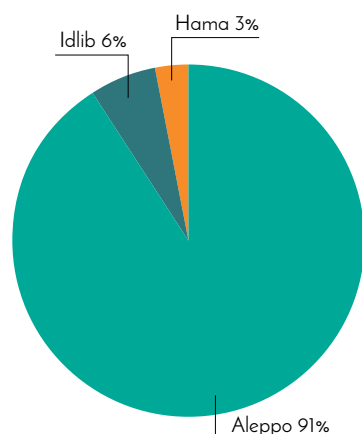
Table 3: Cost of Total Damage to Housing Assets (Million USD)

City	Cost of Total Damage to Housing Assets (Million USD)	
	Low Impact Estimates	High Impact Estimates
Aleppo	4,089	4,998
Hama	142	174
Idlib	278	339
Total	4,509	5,511

Aleppo has seen a dramatic increase in destruction since the March assessment. It should be noted that due to Aleppo's pre-crisis stature as the largest city in Syria its share of the overall damage is sizable compared to the other cities in this assessment. So while Aleppo has borne a similar proportion of damage to its housing stock as Idlib, the damage in Aleppo comes to roughly US\$4 to 5 billion. This accounts for 91 percent of the total housing damage for the three cities, as shown in Figure 11.

However, as figure 10 shows, Idlib's housing stock has also suffered considerably relative to its baseline. The portion of Idlib's housing damaged more than doubled since March 2016, increasing from 14 percent to 32 percent of the housing stock. In financial terms, the cost is of the destruction is estimated to be around US\$277– US\$339 million. This is a jump from 9 percent to 16 percent of the housing sector's value.

Figure 11: Monetary Percentage of Total Destruction by City



Hama's housing stock remains comparatively less affected, experiencing damage to 6 percent of its pre-crisis housing stock. In financial terms the damage to homes there amounts to approximately US\$142 – US\$174 million. This is a loss of 3.8 percent of the pre-crisis baseline value.

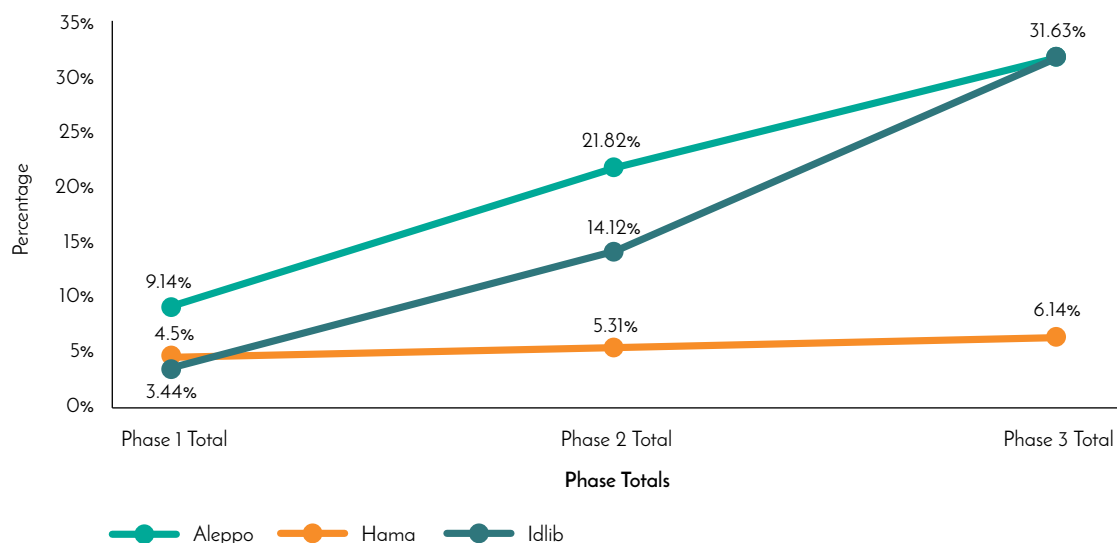
Table 4: Total Damage Inventory

Total Damage Inventory Consolidated for all Three Cities/Neighborhoods Assessed				
Asset Type	Baseline (units)	Destroyed (units)	Partially Damaged (units)	Total Damaged (units)
Apartment	751,518	46,099	148,586	194,685
Popular Housing	75,797	12,960	26,916	39,876
Villa	813	30	95	125
Traditional Arab	4,366	498	998	1,495
Country House	135	10	9	19

Table 5: Average Housing Damage Percentage by City – Comparison Dec 2014, Mar 2016, and Feb 2017

Inventory Based Percentage Destroyed and Damaged									
City	Partially Damaged			Completely Destroyed			Total Damaged		
	Dec-14	Mar-16	Feb-17	Dec-14	Mar-16	Feb-17	Dec-14	Mar-16	Feb-17
Aleppo	5.9%	17.5%	23.9%	3.3%	4.4%	7.8%	9.1%	21.8%	31.6%
Hama	1.2%	1.7%	2.5%	3.2%	3.7%	3.7%	4.5%	5.3%	6.1%
Idlib	3.2%	9.4%	25.2%	0.1%	4.7%	6.3%	3.4%	14.1%	31.6%

Figure 12: Percentage of Baseline Inventory Destroyed or Damaged



General Impacts from Damage to Housing Assets

With housing units being destroyed or damaged while others are being occupied by internally displaced persons, the current conflict has severely compounded the chronic housing shortage in the country in general and for the three urban agglomerations in particular.

As of 2017, about 4.8 million people¹⁸ have left the country and about 5.7 million¹⁹ are internally displaced. In other words, around half of the 20 million people who lived in the country before the conflict have left their homes. The estimated 5.7 million IDPs have overwhelmingly settled in cities, thereby increasing the urbanization rate of the country.

Reportedly, most IDPs have stayed within their own governorate, moving to more stable areas. The displaced primarily a) rent units/rooms; b) live in formal and informal camps and collective centers (schools, hospitals); c) settle informally; or d) stay with friends or relatives. The number of displaced seeking housing has created a huge demand for housing while simultaneously the damage to the existing stock and unsafety of certain location has reduced the housing supply. As a result, in cities that are relatively secure, there is a large mismatch between available housing units and the number of people in need of housing. As demand far exceeds supply, rents have skyrocketed and the impact of this increase has been felt strongly by Syrian renters in general.

The three main constraints to accessing adequate shelter all relate to insufficient financial resources: lack of money, income or resources to buy tools and material to repair shelters; lack of resources to rent shelter, and the increase in rental prices.²⁰

The impact of the destruction of homes represents a reduction in both wealth and the available capital stock. Housing is the main asset for many families. Banks and other financial institutions may incur significant losses due to housing units that were debt financed. Furthermore, damage to housing affects the overall quality of life for all citizens living in damaged units regardless of whether they are owners or tenants.

¹⁸ UNHCR Jan 2017.

¹⁹ IOM Jan 2017.

²⁰ UNOCHA, REACH, SNAP, MSNA Syria Multi-Sectoral Needs Assessment, October 2014.

B. Impact on Urban Space and Population Movement

The population of the three examined cities has fluctuated between growth and shrinkage. In many cases, these cities have experienced both growth and shrinkage in a consecutive manner. This has been the result of outward migration and reverse population movement caused by the shifting dynamics of the conflict.

For example, Idlib city's population peaked around May 2016 due to IDP inflows. OCHA estimates that in late May there were 45,000 total families (IDPs and native residents) living within the city. Between early June and August 2016, a significant intensification of aerial bombardment accelerated the outward migration of roughly 30,000 families. Around 4,000 of these families reportedly sought refuge in villages in the immediate vicinity of Idlib city while roughly 5,000 moved to other parts of Idlib Governorate. The remaining 21,000 households displaced over this period presumably settled in locations outside of Idlib Governorate.

For Hama, security is likely to remain a key pull-factor influencing the settlement pattern of IDPs from all over the country traversing central Syria due to the location's relative stability, despite periodic conflict in parts of Hama Governorate away from the city.

Although Hama, like all other cities, has witnessed outward migration, the urban center has experienced limited fighting relative to the rest of Syria and has remained firmly under regime-control. Instability— primarily in Homs, Idlib, Aleppo, Raqqa, and Deir ez-Zor, as well as in northern and southern Hama Governorate—has resulted in a significant trend of inward migration and settlement in Hama.

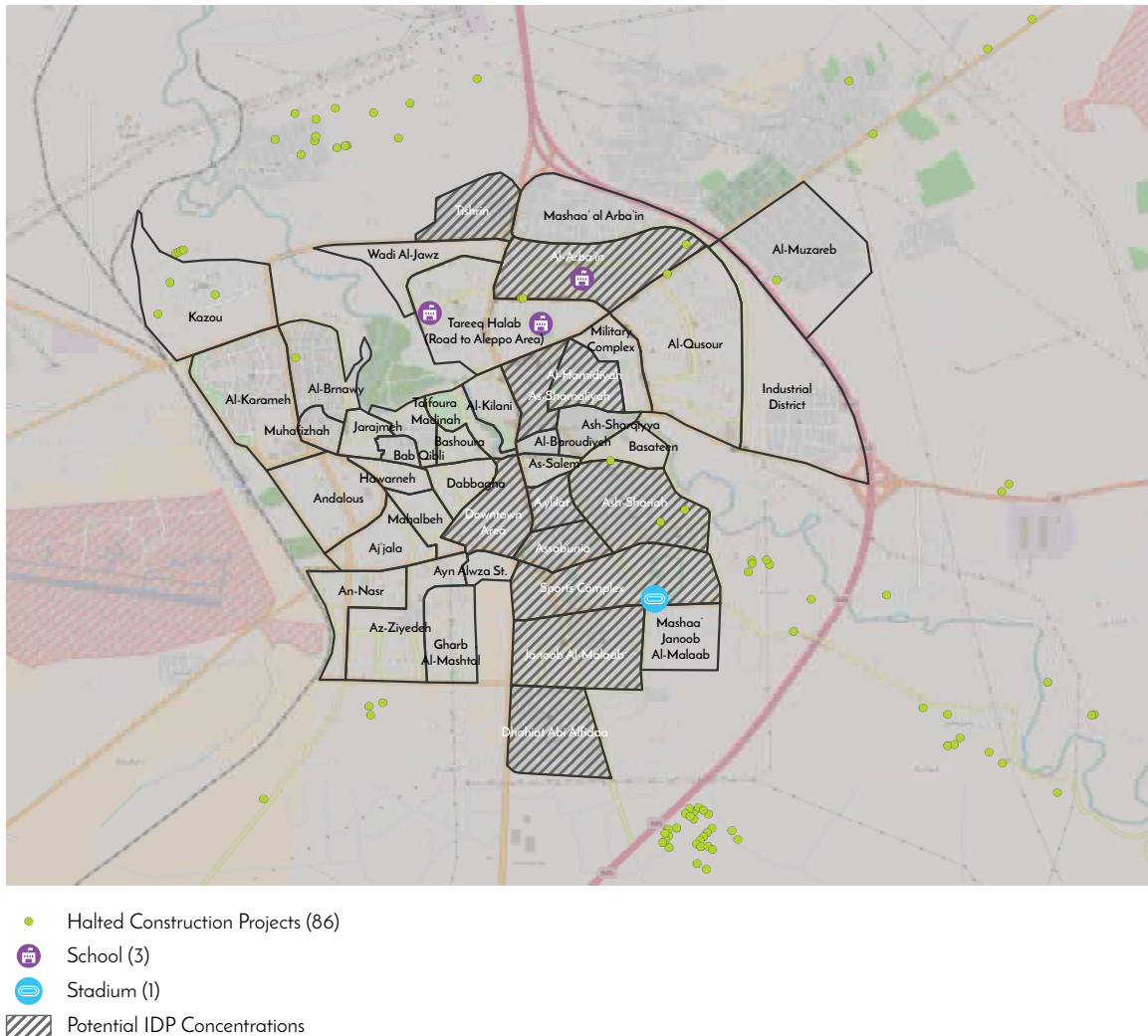
Availability of shelter is a critical pull factor in terms of sub-urban settlement; IDPs with less financial means have faced shelter challenges and sought settlement in areas designated for the displaced (e.g. the camp in the city's sports complex) as well as informal and unfinished buildings. IDP settlement in schools and mosques has also taken place in the city. By 2015, the Syrian Arab Red Crescent (SARC) projected the IDP population in the city to be roughly 400,000.²¹

While displaced Syrians are settled throughout and around the city, clusters of rent increases, population stresses, and infrastructure upgrades evidenced in ground survey data gathered in September 2016, as well as publicly available sources, suggest that IDPs may be concentrated in the southern, eastern, and far northern neighborhoods of the city, as well as its outskirts.

Another type of population mobility can be seen at the intra-city level, where people are moving from one neighborhood to another driven by a variety of pull and push factors. Some factors are critical in IDPs' choice of where to resettle, such as security and stability and average rent levels. Others are significant, including cost of bread, fruit and vegetable supply, and water access. Some final categories that have had a moderate effect compared to the aforementioned factors are garbage removal availability, household connection to sewage, and power access. For instance, Al-saha at-tahtaniyya neighborhood in north central Idlib city is one of the most attractive destinations to incoming IDPs because of the area's relative stability and security, good water access, and low rent costs. Conversely, Al-dabit neighborhood in western Idlib may be the least desirable IDP settlement location due to its relatively poor security environment, high rents, and a lack of access to water.

²¹ <https://www.newsdeeply.com/syria/articles/2016/09/13/re-engineering-the-population-in-hama> and <http://tinyurl.com/jgfl7hc>

Figure 13: Hama City IDP Settlement Patterns

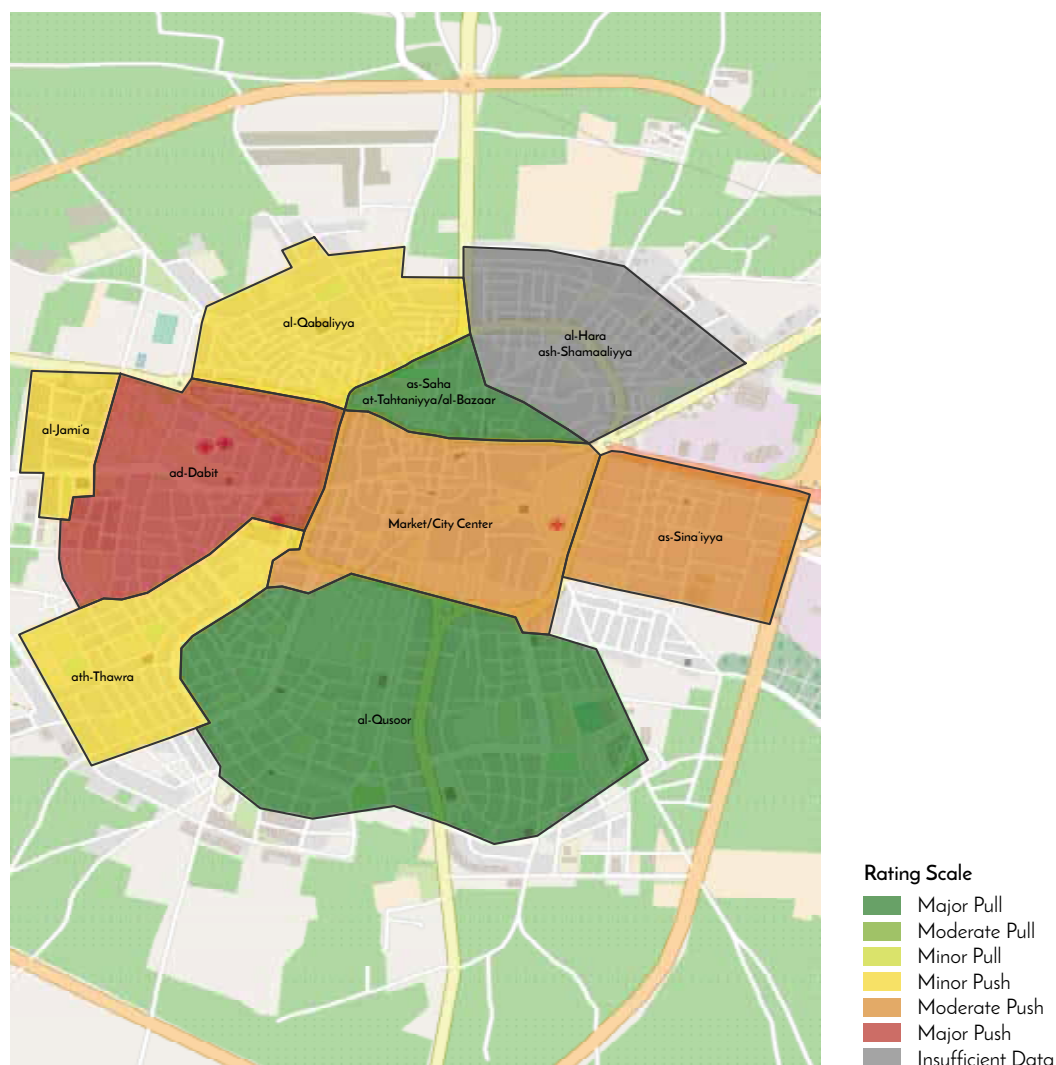


*The high concentration of halted construction to the NW and SE of the city is likely a draw for local IDP settlement

Similar intra-neighborhood dynamics could be seen in Aleppo. Following the intensified conflict at the end of 2016 there was an escalation of population displacement between November and December 2016. According to official humanitarian records, 121,350 people from Eastern Aleppo were registered as displaced as of 20 January 2017, with 65,345 of those displaced remaining in Eastern Aleppo. At the same time 50,929 of the displaced were residing in Western Aleppo, and 5,077 sheltering in an IDP center in the Jibrein Industrial Area near the Aleppo Airport. While significant numbers of recently displaced people remained within Eastern Aleppo neighborhoods, others departed for the Kurdish district of Shaykh Maqsood or for Western Aleppo. The displaced often stayed in mosques and abandoned buildings and chose to stay close to their place of origin in the hope that they can come back after a cessation of hostilities.²²

22 <http://reliefweb.int/report/syrian-arab-republic/syrian-arab-republic-aleppo-situation-report-no-14-20-january-2017-enar>

Figure 14: Idlib Push/Pull Factor Ratings by Neighborhood

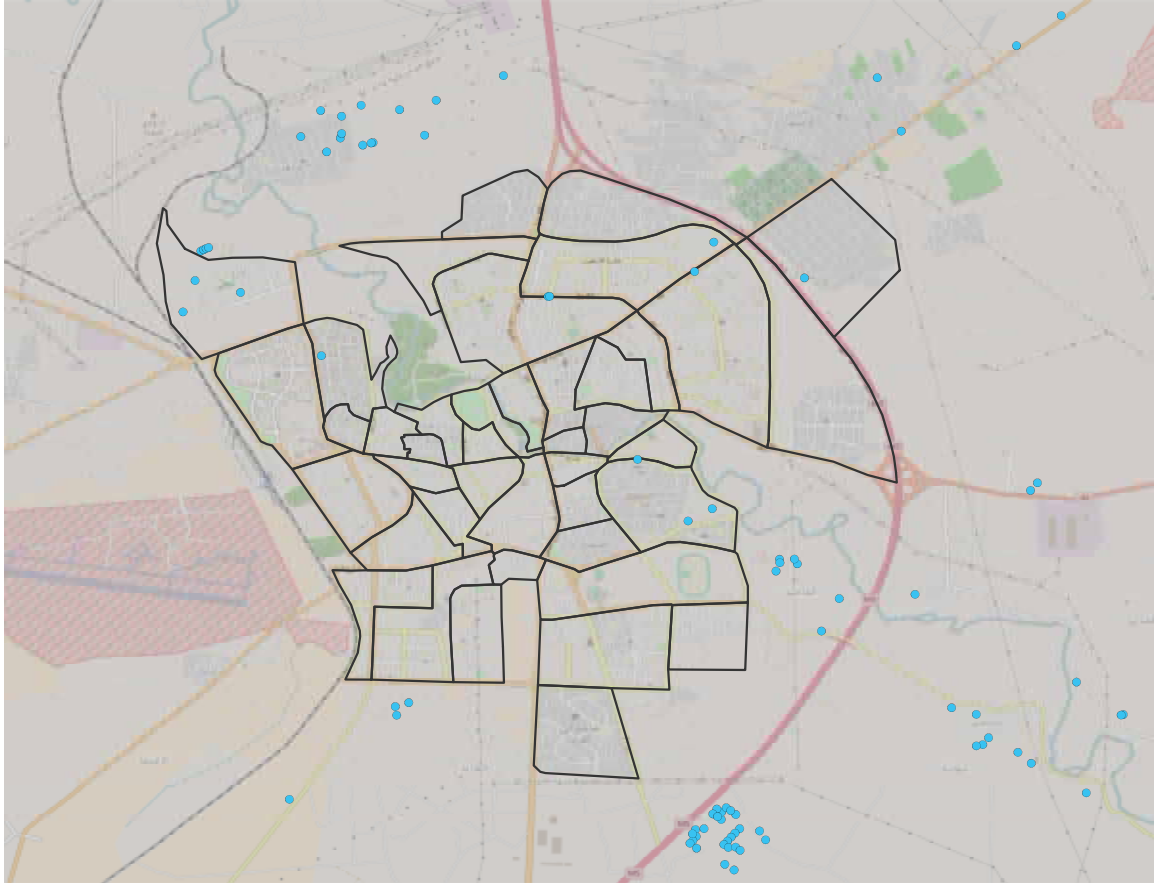


The urban footprint is being widely affected by the conflict and population movement. For example, the signs of halted construction projects around the outskirts of Hama show a break in the predicted growth of the urban core of the city and a change in the occupancy status of these areas. Unfinished buildings have, after quick fixes, become locations for IDPs seeking shelter. Closely examining past IDPs displacement patterns is one way to predict future population movement trends.

The pre-war population of Syria was 20 million in 2010. The estimated population within the country, as of January 2017, is 18,782,000. The 2017 population estimate includes a total of 5,715,168²³ persons who are internally displaced within the country. It does not include refugee totals. The total number of Syrians registered as refugees outside of the country in Lebanon, Turkey, Jordan, Iraq, Egypt, and North Africa is 4,863,684²⁴.

²³ IOM Jan 2017.
²⁴ UNHCR Jan 2017.

Figure 15: Hama–Halted Construction Projects (September 2016)



• Halted Construction Projects (86)

HEALTH

A. Damage Assessment

The damage to the health system in the three cities surveyed (Aleppo, Hama, and Idlib) in this phase of the Syria DA is estimated to range between US\$255 million - US\$312 million, which represents a significant increase over the March 2016 and December 2014 assessments.²⁵ The substantial damage witnessed to health facilities is corroborated by accounts from several reputable international organizations, NGOs and activists with field presence including the International Committee of the Red Cross, Médecins sans Frontières, International Refugee Committee, Human Rights Watch, and the European Commission. Physicians for Human Rights have documented 454 attacks on 310 separate facilities and the death of 796 health personnel in Syria between March 2011 and the end of December 2016.²⁶ This is corroborated by the Syrian American Medical Society which has documented a nearly 90 percent increase in the number

²⁵ These are conservative estimates which do not adjust for inflation.

²⁶ "Anatomy of a Crisis: A Map of Attacks on Health Care in Syria," *Physicians for Human Rights*.

of attacks on medical facilities and personnel in Syria following the May 3, 2016 passage of UN Security Council Resolution 2286, which condemns attacks on medical facilities and personnel in conflict zones.²⁷ Unfortunately, since the initial data was collected in July 2016, the attacks on health facilities have continued. Bombing of key hospitals in Aleppo have taken place in April, May and December 2016.²⁸ It is now estimated that one attack takes place on medical facilities or personnel every 48 hours.²⁹

The targeting of health facilities and medical personnel has led to provider flight and a hollowing out of the entire health system. Interviews carried out by the World Bank health team in Amman and Beirut with UN Agencies and NGOs working inside Syria in July 2016 revealed a health system in crisis. Organizations working in the field referred to an acute shortage of health professionals, with medical residents, or in cases veterinarians being the only providers in towns under siege. There is an especially acute shortage of female doctors (especially obstetricians and gynecologists) which has severely affected access to health care for half the population. Due to the unpredictable security situation, women are increasingly scheduling caesarian sections (as opposed to having a normal vaginal delivery which is difficult to predict) and leaving as soon as they come out of anesthesia due to fear of their hospital being bombed. This procedure is considered a major surgery and usually requires a four to five day inpatient stay to ensure safe recovery.

Despite these obstacles, NGOs, humanitarian agencies, and UN groups continue to provide health care through innovative methods – building hospitals underground or spreading out different wards to prevent destruction via air campaigns; providing diagnosis via WhatsApp with specialists abroad due to physician shortages; training future cadres of health professional through online courses held in bunkers; and developing cross border pharmaceutical supply chains and payment systems to allow for medicines and salaries to reach besieged towns. The very nature of the practice of medicine has been transformed by innovation as this seems to be the only way to continue to provide care after six years of conflict.

Despite these isolated islands of innovation, the destruction of the existing health infrastructure has led to a deterioration of health status across the country with a reemergence of communicable diseases, heightened impact of non-communicable diseases, and increasing burden of injuries. Communicable diseases such as polio, leishmaniasis, measles, tuberculosis, and diarrhea have increased.³⁰ In addition, non-communicable diseases such as cancers, diabetes, and cardio vascular diseases continue to result in avoidable deaths as patients cannot get access to chemotherapies or simple life saving medications. Children are especially vulnerable; According to a 2013 Save the Children Report, up to 2 million children in Syria are suffering undernourishment in both macro- and micronutrients, which alters growth trajectories in the early stages of child development, propagating effects over the life-course and affecting adult stature, risk of illness and potential earning capacity.³¹ This has been exacerbated greatly by the conflict. Discussions with health organizations revealed a witnessing of acute malnutrition among older adults in besieged towns as they gave any available food to their children. In addition, mental health conditions are on the rise with a projected increase in

27 "The Failure of UN Security Council Resolution 2286 in Preventing Attacks on Healthcare in Syria," *Syrian American Medical Society* (2017).

28 "Rebel shelling hits Aleppo hospital amid cease-fire efforts," *Washington Post*, (2016).

29 *Syrian American Medical Society*, 2017.

30 Z. Ben Taleb, R. Bahelah, F.M Fouad, A. Coutts, M. Wilcox, & W. Maziak, "Syria: health in a country undergoing tragic transition." *International Journal of Public Health*, (2015): 60 Suppl 1, S63-72. <https://doi.org/10.1007/s00038-014-0586-2>.

31 D. Devakumar, M. Birch, L.S. Rubenstein, D. Osrin, E. Sondorp, & J.C.K. Wells, "Child health in Syria: recognising the lasting effects of warfare on health." *Conflict and Health*, (2015): 9.

anxiety, depression and post-traumatic stress disease as a direct result of the conflict.³² This is especially acute in children who are being classified as having levels of “toxic” stress. It is now estimated that more people have been killed within Syria due to a breakdown of the health system than due direct fatalities from the fighting.

Vaccination coverage rates are a good indicator of the status of a health system. To ensure routine immunizations, all parts of the health system have to function—from education campaigns and infant wellness visits to creating demand for vaccines, to well-functioning supply lines with cold chains in place to deliver the vaccines, and to community health workers and nurses to supply the vaccine. Polio, long thought to be eliminated, has re-emerged and spread across the region due to the inability of delivering routine immunizations.³³

In terms of physical damage to infrastructure, more than 80 percent of health facilities in Idlib and more than 60 percent of health facilities in Aleppo have faced some form of damage (completely destroyed or partially damaged; Figure 16) as of February 2017.

In terms of damage by type of facility, more than half of all hospitals and medical centers have been affected, resulting in a shortage of beds and medicines to treat patients (Figure 17).³⁴ The damage to hospitals is of particular concern as it affects the bed capacity and ability of the system to provide critical inpatient care.

The level of damage to the health sector in the three cities (Aleppo, Hama, Idlib) was estimated to range between US\$255 and US\$312 million as of February 2017 (see Table 7). These numbers are based on estimates of unit cost data from local sources in Syria as well as estimates from neighboring countries in the region.³⁵ Estimates for hospital damage are based on average size of damaged hospitals based on per city size estimates provided in December 2014, while the value of damages for primary and secondary facilities are calculated as lump sum fixed costs per type of facility since size tends to be uniform. All costs include damage to infrastructure, but do not include cost of land acquisition (assuming that facilities could eventually be rebuilt on the same parcels of land) and content destruction (e.g. medicines, laboratory equipment, etc.). High and low estimates were calculated at 10 percent of total estimated costs.³⁶

32 “Syria’s Health: An Overview of Current Knowledge and Policy Priorities,” *Syria Public Health Network* (2016).

33 A. Sparrow, “Syria’s Polio Epidemic: The Suppressed Truth,” *The New York Review of Books* (2014).

34 In cases where data was missing, damage ratios from similar facilities in that city were used to impute what potential damage may have occurred.

35 Hospital costs were calculated using cost data from Egypt where cost of rebuilding 1m² of a medical facility is \$1700 and size data was based on satellite footprint. The cost of rebuilding a medical center/medical point was estimated at \$428,000 and rebuilding a medical center (specialized) at \$1,100,000 based on data from Egypt. The cost of rebuilding a polyclinic/rehab centers was estimated to be \$4,500,000 based on data from Yemen. The cost of rebuilding a pharmacy/medical training center, based on estimates from Syrian sources is \$67,000. Due to fluctuations in Syrian currency, all costs are kept in US\$ of comparator country (i.e. no GNI ratio conversion was done). The cost of rebuilding a “partially damaged” facility were estimated at 40% of total costs.

36 The high estimate is 10 percent higher than the estimated cost and the low estimate is 10 percent lower than the estimated cost.

Table 6: Total Damage Inventory

Asset Type	Number			
	Baseline	Total Damaged	Completely Destroyed	Partially Damaged
Private Hospital	117	57	10	46
Public Hospital	17	9	3	6
Hospital (unknown)	13	9	4	5
Medical Center (Public)	4	3	0	3
Medical Center (Private)	125	76	58	18
Medical Center (Unknown)	0	0	0	0
Specialized Medical Center	4	1	1	0
Medical Point	3	2	0	2
Polyclinic	5	2	1	1
Total	288	159	78	81

Figure 16: Damage to Total Health Facilities by City

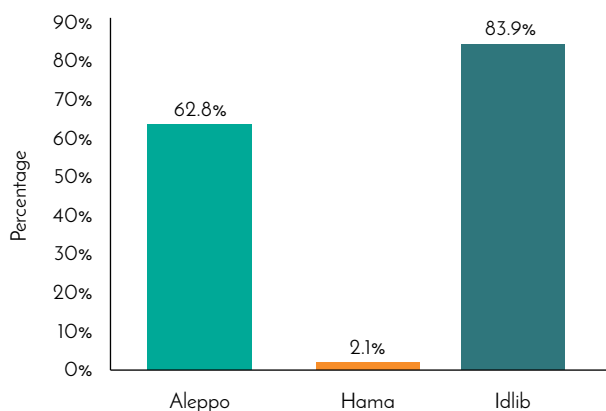


Figure 17: Damage Across All Five Districts by Facility Type – February 2017 Update

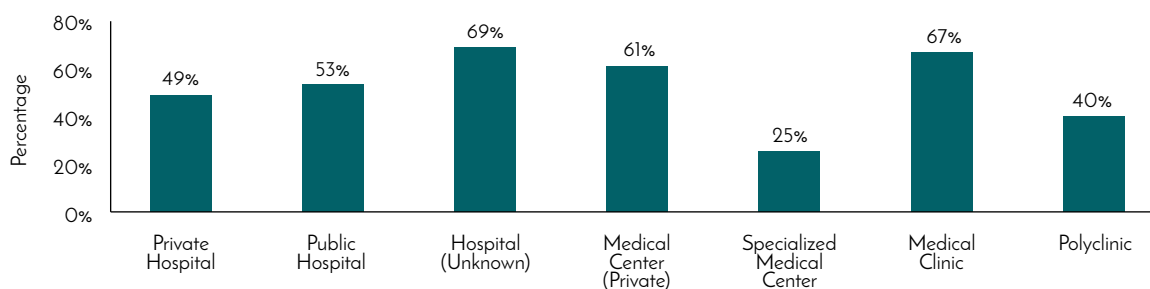


Table 7: Estimated City-Specific Damage Costs in US\$ million in the Health Sector

City	USD Million	
	Low Damage Estimate	High Damage Estimate
Aleppo	\$198.96	\$243.17
Hama	\$1.62	\$1.98
Idlib	\$54.33	\$66.4
Total	\$254.91	\$311.55

B. Impact on Service Delivery

The conflict has resulted in provider flight, further curtailing service delivery. Apart from direct hits to infrastructure, the instability due to the conflict has led to provider flight and a shortage of trained medical personnel to deal with the increasing medical need. This dramatic erosion of the health workforce is evident in the last three years. In February 2014, it was estimated that 15,000 doctors had fled Syria.³⁷ In May 2015, it was estimated that there were only 62 of the estimated 6,000 physicians left in all of Aleppo and 12 surgeons remaining in the Sunni part of Homs.³⁸ By May 2016, this had severely worsened with one of the last pediatricians in Aleppo believed to have been killed in an airstrike. In addition, providers are thought to be reimbursed at very low rates, with reimbursement rates for medical exams being equivalent to US\$1.³⁹

Equipment and medicine shortages have further hamstrung the system. Due to the damage to health facilities, functioning equipment is in short supply. For example, it is believed that there is only one functioning CT scan machine in Idlib⁴⁰ and a shortage of functioning X-ray and MRI machines and neonatal incubators across all three cities (often due to a lack of spare parts and reagents). In addition, even in cities with relatively little damage to the health infrastructure such as Hama, there is a national shortage of medicine due to the collapse of the domestic pharmaceutical market which is hampering the ability to provide care and leading to a proliferation of drugs on the black market with little regulation. The shortage of medicine has been compounded by the difficulties of medical convoys to provide relief.⁴¹

The health situation has further deteriorated with an increase in injuries and untreated complications due to non-communicable diseases. As summarized by the head of the Syrian American Medical Society, some 200,000 people have died in Syria because they did not have access to routine medical care as of February 2014.⁴² These are in effect a "secondary death toll" that is even higher than those killed by bombs and firearms.⁴³ "These are the women who died in labor because there was no one to do a C-section, or the men who have a heart attack and cannot find a physician, or have complications from diabetes. People are dying of chronic diseases that three years ago would have been completely manageable."⁴⁴

37 A. Baker, "Syrian Doctors Flee the War, Leaving a Health Crisis in Their Wake," *Time* (2014).

38 Sparrow, Syria's Polio Epidemic: The Suppressed Truth.

39 Sparrow, Syria's Polio Epidemic: The Suppressed Truth.

40 Sparrow, Syria's Polio Epidemic: The Suppressed Truth.

41 C. Lynch, "Syria's War on Medicine," *Foreign Policy* (2014).

42 A. Baker, Syrian Doctors Flee the War, Leaving a Health Crisis in Their Wake.

43 A. Baker, Syrian Doctors Flee the War, Leaving a Health Crisis in Their Wake.

44 A. Baker, Syrian Doctors Flee the War, Leaving a Health Crisis in Their Wake.

TRANSPORT

A. Damage Assessment

Information regarding the road transport institutional set-up, road sector inventory, and road conditions in Syria are very limited, resulting in difficulties to establish accurate baseline data regarding the state of the road sector before the start of conflict in 2011.

This report provides a preliminary quantification of the physical damage to the intra-urban road transport sector in Hama, Idlib and Aleppo.

The following table gives a comparison of the scope of the three phases:

Table 8: Road Transport Sector's Comparison between Dec. 2014, Mar. 2016, Sep. 2016 and Feb. 2017

Road Transport Sector				
	Phase 1	Phase 2	Phase 3a	Phase 3b
Damage Assessment Data	December 2014	March 2016	September 2016	February 2017
Geographic Coverage	Aleppo, Dara'a, Hama, Homs, Idlib and Latakia	Aleppo, Dara'a, Hama, Homs, Idlib and Latakia	Aleppo, Hama and Idlib	Aleppo, Hama and Idlib
Damage Estimate (Million USD)				
Low Estimate	180	127	130	607
High Estimate	221	156	221	667

Damage to bridges were considered in the February 2017 analysis. In general, damaged spans are replaced rather than repaired. Furthermore, damage to airports and railways are only estimates by the team, based on satellite imagery analysis, and are not supported by baseline data from previous DA phases. These facilities have experienced low damage and continued to function during the conflict.

Public buses are the most common mode of transportation, although there is only limited access to the majority of bus stops and stations throughout the cities. Analysis of satellite imagery for the three cities indicates that road repairs and maintenance have been active, primarily in government-controlled neighborhoods, where local authorities' teams are removing debris and rehabilitating roads in an attempt to keep the roads accessible.

For the purpose of this analysis, and due to absence of data, this assessment estimates that at least an additional 20 percent of the total estimated damages should be added to the February 2017 estimates to account for private and public property damage to such assets as cars, vehicles, etc.

Characterization of Damage Overview

Approximately 28 percent of the total intra-city road length had been directly and indirectly impacted by the conflict as of February 2017. However, the impact on road functionality extends far beyond direct road damage. Large segments of intra-urban roads are often rendered inaccessible due to direct damage to short segments, which has more substantial impact on overall mobility than suggested by the degree of direct damage. Primary roads and trunk roads have received the most damage with around 5-10 percent of their respective total lengths having been affected.

Aleppo continues to be the most impacted city, accounting for the majority of the damage in the three cities. Damage to Aleppo's road transportation sector has doubled since September 2016. Approximately 25 percent of bridges are impassable, and 65 percent of roads are in need of basic repairs due to lack of maintenance in addition to conflict-related damages.

Figure 18: A Side-By-Side Comparison of 1 August 2016 and 1 December 2016 Imagery of a Southern Interchange of Aleppo's Outer Ring Road (located at 36.159, 37.167) Shows an Increase in Blockages Hindering Access into/out of the City from this Point



The baseline data for this assessment is based on satellite imagery taken in September 2011. The recorded totals by asset class were recorded as follows:

Table 9: Pre-Crisis Baseline

Road Class	Pre-Crisis Baseline (Km)			Total Baseline (Km)
	Hama	Idlib	Aleppo	
Motorway	22,060	-	4,286	26,346
Trunk	18,677	5,344	147,238	171,259
Primary	72,634	33,854	158,494	264,982
Secondary	100,980	24,906	219,387	1,345,273
Tertiary	18,586	19,076	218,235	255,897
Track	7,859	4,590	139,154	151,603
Residential	436,535	144,239	2,161,568	2,742,342
Service	28,049	9,575	183,572	221,196
Unknown	46,455	37,429	249,044	332,928
Bridge	1,869	231	10,535	12,636
Total (Km)	753,706	279,244	3,491,514	4,524,464

Effect on infrastructure and physical assets

The majority of the road damage in the three cities is conflict-related, mainly attributed to bombardment, collateral damage, lack of maintenance, man-made barricades and security check points blocking free movement of people and vehicles.

Figure 19: Roads in the Industrial District of Aleppo Blocked with Debris after a November 2016 Shelling Attack



Transport is particularly important for the prospects of refugees and IDPs returning to their homes. Many roads remain passable by standard cars despite widespread destruction due to bombardment along with collateral damage, but access is limited for heavy trucks and aid convoys. In Aleppo, for example, social media reporting indicates public buses are the most common mode of transport. In government-held areas, local agencies are reactivating bus routes that were discontinued due to the conflict. Social media reporting also suggests that government forces may be cooperating with rebel groups to allow public bus transportation to and from the surrounding towns and villages. Motorcycles and walking remain the most common modes of transport in the three cities. This is attributed mainly to the widespread damage to local roads, as well as to the high fuel prices the three cities and surrounding countryside have been experiencing since the start on the conflict.

(Damage quantification table, by city/Dollar value)

Table 10: Three Cities Rollup–Feb 2017

Asset Type	Million USD)			
	Baseline	Total Damaged	Completely Destroyed	Partially Damaged
Motorway	0.4	3	0	3
Trunk and Primary	9	80	62	18
Secondary	6	50	46	13
Tertiary	2	67	57	11
Other Roads	15	247	198	49
Bridge	8	43	43	0.3
Total Roads and Bridge	39	512	406	107
Airport	-	50	-	50
Railway	-	25	-	25
Total	39	587	406	182

Table 11: Total Three Cities Range, (Monetary)

City	Feb 2017 Low Damages US\$M	Feb 2017 High Damages US\$M
Hama	114	117
Idlib	18	18
Aleppo	476	532
Total	607	667

B. Impact on Service Delivery

The number of damaged linear meters is much higher compared to the damage assessed in the previous survey of September 2016. It represents about 60 percent of all road assets in the three cities as of February 2017. Depending on the spatial placement of the damaged areas, isolation of small road segments could have more substantial effects on overall mobility than immediately apparent from the percentage of overall damage. Therefore, more analysis is needed to determine the exact impact of the damage on service delivery. Of these three cities, Aleppo is most impacted by damage and service delivery reduction in the sector. Data analysis show that 65 percent of the total road network in Aleppo is damaged. This is attributed to the prolonged siege and bombardment the city has sustained since 2012.

Figure 20: 16 December 2016 Photos from Aleppo. Karm al-Qaterji Main Roads are Passable, but Smaller Roads Still Contained Debris at the Time⁴⁵



ENERGY

A. Damage Assessment

This section outlines the extent of damage to the power sector infrastructure for the three cities (Aleppo, Hama and Idlib) and provides quantification (US\$ value) of the losses resulting from the ongoing conflict between various factions. The October 2016 assessment of the power sector in Syria captured the extent of damage for the three cities. The Aleppo assessment was further revised as of February 2017, to take into account heavy conflict there and significant damage sustained to the electricity network. A baseline for facilities was developed to include:

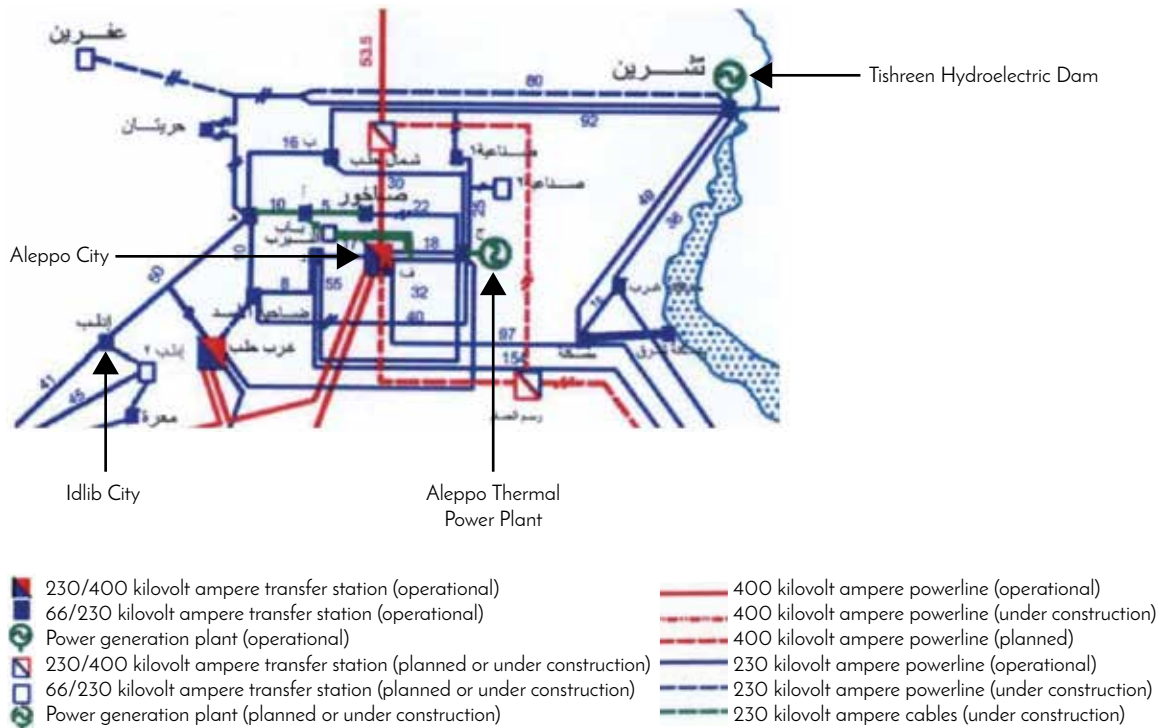
⁴⁵ <https://www.facebook.com/search/top/?q=%D9%83%D8%B1%D9%85%20%D8%A7%D9%84%D9%82%D8%A7%D8%B7%D8%B1%D8%AC%D9%8A>

power plants, substations, towers (for capturing the presence of high voltage power lines), transformers, and energy administration offices. However due to limitations in the availability and accuracy of information on the extent of damage to the transmission and distribution network, the financial calculation of the damage is based on three facility classifications, i.e. power plants, substations and transmission towers. The peripheral parts of the network including administration offices have been excluded.

A damage/functionality assessment was conducted on facilities located within urban boundaries using a two-step process: 1) examination of recent imagery for damage signatures and 2) review of social media analytics and publicly available sources. While imagery analysis served as the initial source of damage data, qualitative reporting streams were consulted to validate and refine imagery findings and provide the main source of functionality data. Due to limitations on imagery coverage, facilities located outside of the cities were assessed on the basis of qualitative sources only. The critical facilities such as power plants and substations are prioritized to elaborate on city level damages to power infrastructure.

Aleppo: Since the start of the conflict in 2011, Aleppo has witnessed the most destruction to the infrastructure and disruption to services overall. Please see below the facility specific damage reports for critical electricity generation and distribution facilities.

Figure 21: Aleppo Power Grid, Pre-Crisis



Aleppo's thermal power plant is the largest in the country, generating 1100 MW of electricity and the major source of the electricity supply to Aleppo city. The thermal power plant accounted for approximately 60 percent of the city's needs prior to the conflict.⁴⁶ In February 2016, Syrian Government forces recaptured the Aleppo Thermal Power Plant from opposition factions. As of February 2017, the Aleppo Thermal Power Plant has been categorized as fully destroyed as a result of significant damage sustained in the last few months. As a result, the estimated cost of rehabilitation of Aleppo power infrastructure has increased. Publicly available information indicates that residents of eastern, central, and southwestern neighborhoods of Aleppo receive no electricity from the public network, while western Aleppo has access to no more than two to three hours from the public network daily.

Figure 22: Aleppo Thermal Power Plant Damage (Exterior)

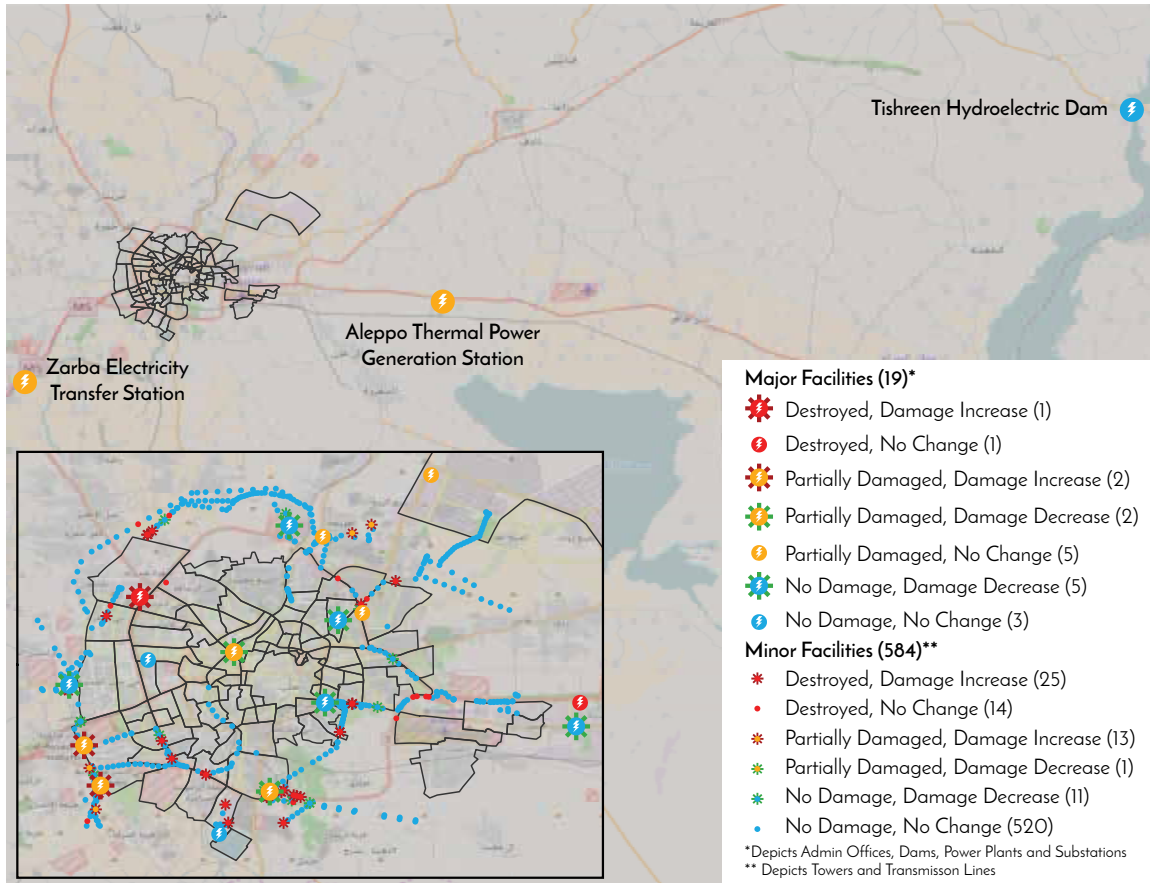


Of the total of 16 substations (Transmission and Distribution - capacities unknown at this stage) one is completely destroyed while 10 are partially damaged. Al-Zarba Power Transfer Station, located south of the city of Aleppo, played a critical role in supplying the city with electricity prior to the crisis because it connected Aleppo to Syria's southern power grid. Local news outlets and ground photos indicate that this facility is currently not functioning due to damages sustained from the conflict. According to the reports, six of the substations (transmission, distribution, capacity unknown) have been repaired or partially rehabilitated in the last few months. However, because of recent fighting, there are two additional substations that have been categorized as partially damaged in the February 2017 estimates.

Hama: Prior to the Syrian crisis, Hama city residents relied on two local power plants and surplus electricity from the northern and southern power grids to supply the city's public electricity network. As of September 2016, both power plants had sustained significant damage as a result of nearby conflict. Additionally, natural gas, diesel, and heavy fuel oil shortages prevent the facilities from operating at full capacity.

⁴⁶ Aleppo Thermal Power Plant Syria." *Global Energy Observatory*. Web. 21 March 2016.

Figure 23: Aleppo Damage to Power Sector



Al-Zara Thermal Power Plant: This facility is located 17 kilometers southwest of Hama city. The plant has five steam-powered turbine units producing 220 megawatts each (total 2013 capacity of steam-powered turbines was 1,100 megawatts). The turbines at this facility operate on natural gas, heavy fuel oil, and a relatively small quantity of diesel fuel. The Al-Zara Thermal Power Plant reportedly came under attack in early March 2016 and July 2016 and went offline at that time causing power shortages throughout central Syria. The extent of the reported damage varies by source, but the facility has likely sustained at least partial damage.

Mhardeh Thermal Power Plant: This facility is located 17 kilometers northwest of Hama city. The Mhardeh Thermal Power Plant has four steam-powered turbine units; and one natural gas-powered unit producing 30 megawatts with a total maximum capacity of 660 megawatts. Natural gas and diesel fuel are the primary power sources used at this facility. Despite attacks in the vicinity and reports of partial damage to the facility, it is likely that this power plant continues to function at partial capacity due to fuel shortages as well as the lingering effects of damage and the need for further maintenance.

There are a total of 7 transmission and distribution substations (capacities unknown) in and around the immediate vicinity of the city. No evidence of damage to these substations had been found or reported as of September 2016.

Figure 24: Hama Damage to Power Sector

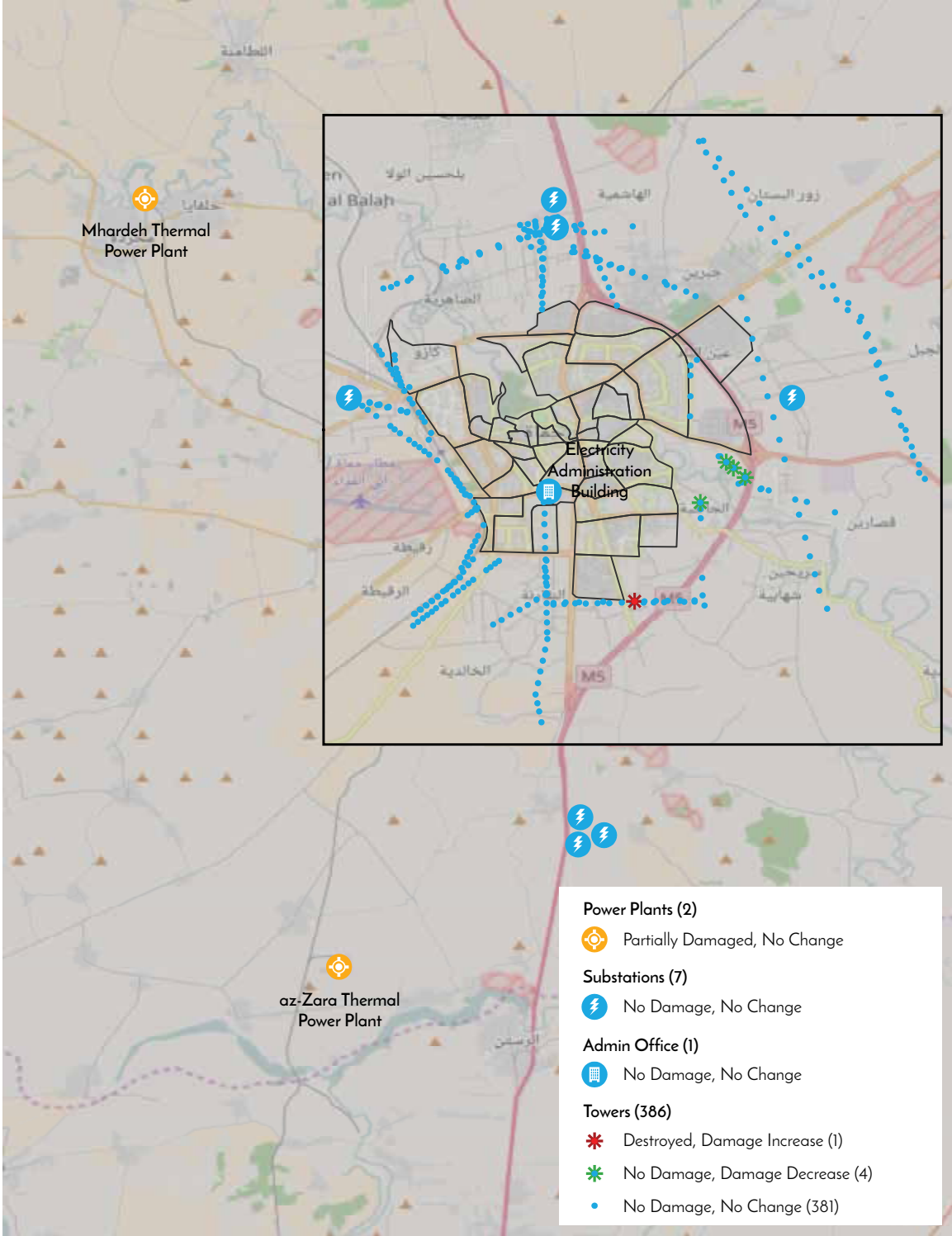
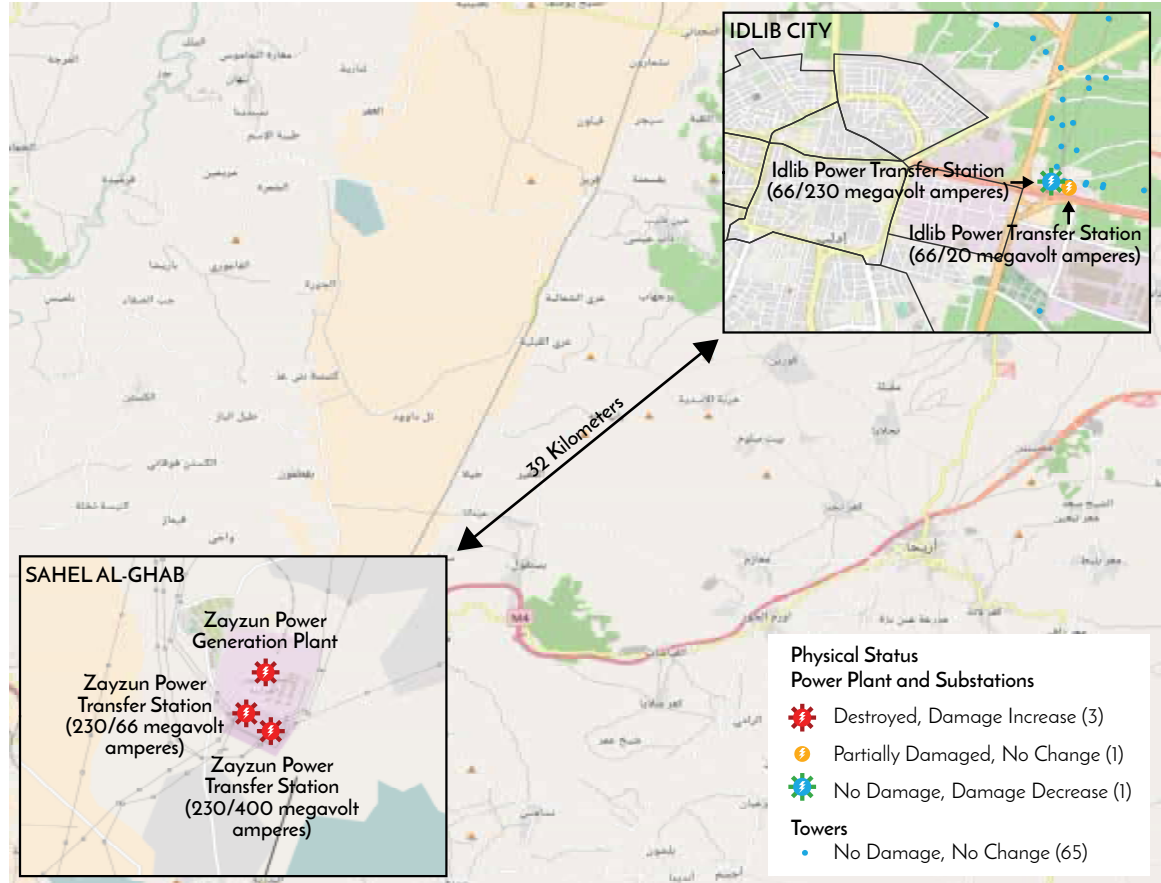


Figure 25: Idlib Damage to Power Sector



Idlib: The energy infrastructure of Idlib Governorate is composed of five primary facilities: one power generation plant and four power transfer stations.

Zayzun Power Generation Plant: This power plant has four gas turbines, three with a capacity of 128 megawatts (built in 1997) and one with a capacity of 160 megawatts (built in 2008). Between August 2015 and August 2016, the Zayzun Power Plant sustained substantial damage as a result of nearby fighting (most taking place in the adjacent Sahel al-Ghab region), looting, and the dismantling of the facility’s metal equipment and housing to be sold as scrap metal. The plant is currently not operational, and due to the extent of damages to the facility, has been designated as ‘destroyed’.

Please see table 12 for the capacities and damage status of the four substations in and around the city of Idlib.

Table 12: Idlib Substation Damage by Substation Capacity

No.	Substation Capacity	Status
1	Idlib Power Transfer Station (66/20 megavolt amperes)	Partially Damaged
2	Idlib Power Transfer Station (66/230 megavolt amperes)	No Damage
3	Zayzun Power Transfer Station (230/400 megavolt amperes)	Destroyed
4	Zayzun Power Transfer Station (230/66 megavolt amperes)	Destroyed

Quantification of Damage to Assets and Infrastructure

The following tables quantify the damage to power infrastructure for electricity generation, transmission and distribution for the three cities. The analysis consequently provides the following comparison with the baseline data points after collection and analysis of imagery and qualitative data for the energy sector.

- a) Total number of energy facilities in city
- b) Total number of energy facilities by type
- c) Total number of energy facilities by neighborhood

All Cities consolidated damage estimate

Table 13: Consolidated Table for Damage by Facility for Aleppo, Hama and Idlib

Facility Classification	Baseline Number (Pre-crisis)	Total Damaged	Completely Destroyed	Partially Damaged
Power Plant	4	4	2	2
Dam	1	0	0	0
Substation	27	14	3	11
Tower	765	77	68	9
Admin Office	1	1	0	1
Totals	798	96	73	23

Table 14: Consolidated Table for Damage Comparison with the Previous Update (March 2016) by Facility for Aleppo, Hama and Idlib

Facility Type	Baseline	Change Detection Summary Physical Status Number For Aleppo, Idlib and Hama		
		No. of Facilities with Increased Damage	No. of Facilities with Decreased Damage	No. of Facilities with No Change
Power Plant	4	2	0	2
Dam	1	0	0	1
Substation	27	5	3	19
Tower	765	64	18	683
Transmission Line	3	0	0	0
Admin Office	1	0	1	0

B. Impact on Service Delivery

The impact of damage to the electricity infrastructure on service provision to each of these three cities is summarized below. Overall, based on the review of the extent of damage and service interruption reports and complaints on publicly available sources and social media, it is clear that Aleppo and Hama are most affected as per the assessment conducted in October 2016. Following that, Aleppo electricity network sustained further damage in the last few months, which was captured in the February 2017 update for Aleppo only. The electricity supply system was strained because of damage to the system's infrastructure, in addition to the large influx of population to Aleppo city, and people moving within the city seeking refuge in areas that were perceived to be relatively safer.

It is also noteworthy that the local population has shown incredible resilience in coping with the challenges of inaccessibility to basic services including electricity by developing local and small business solutions including diesel, solar and wind electricity generators.

Aleppo

Power supply via the public electricity grid in Aleppo is extremely limited and inconsistent due to damage to the Aleppo Thermal Power Plant, al-Zarba Power Transfer Station, and other local power infrastructure. Publicly available information indicates that residents of eastern, central, southwestern neighborhoods of Aleppo receive no electricity from the public network, while western Aleppo residents have access to no more than two to three hours of electricity from the public network daily, although outages are frequent in this area as well. Commercial and private generators have become an important source of electricity, particularly for more affluent residents of western and northwestern Aleppo city. Solar panels, small private generators, and to some degree, makeshift wind-powered turbines have reportedly become more prevalent in southwestern, central, and eastern Aleppo. The image below demonstrates the stark difference between 2014 and 2016, where the damage caused by ongoing conflict has gradually put the city to the dark. The household and small business generators do not often provide electricity at night time and do not provide enough brightness that could be captured by this imagery.

Figure 26: VIIRS Imagery Comparison of Aleppo City Lighting, January 2014 and July 2016

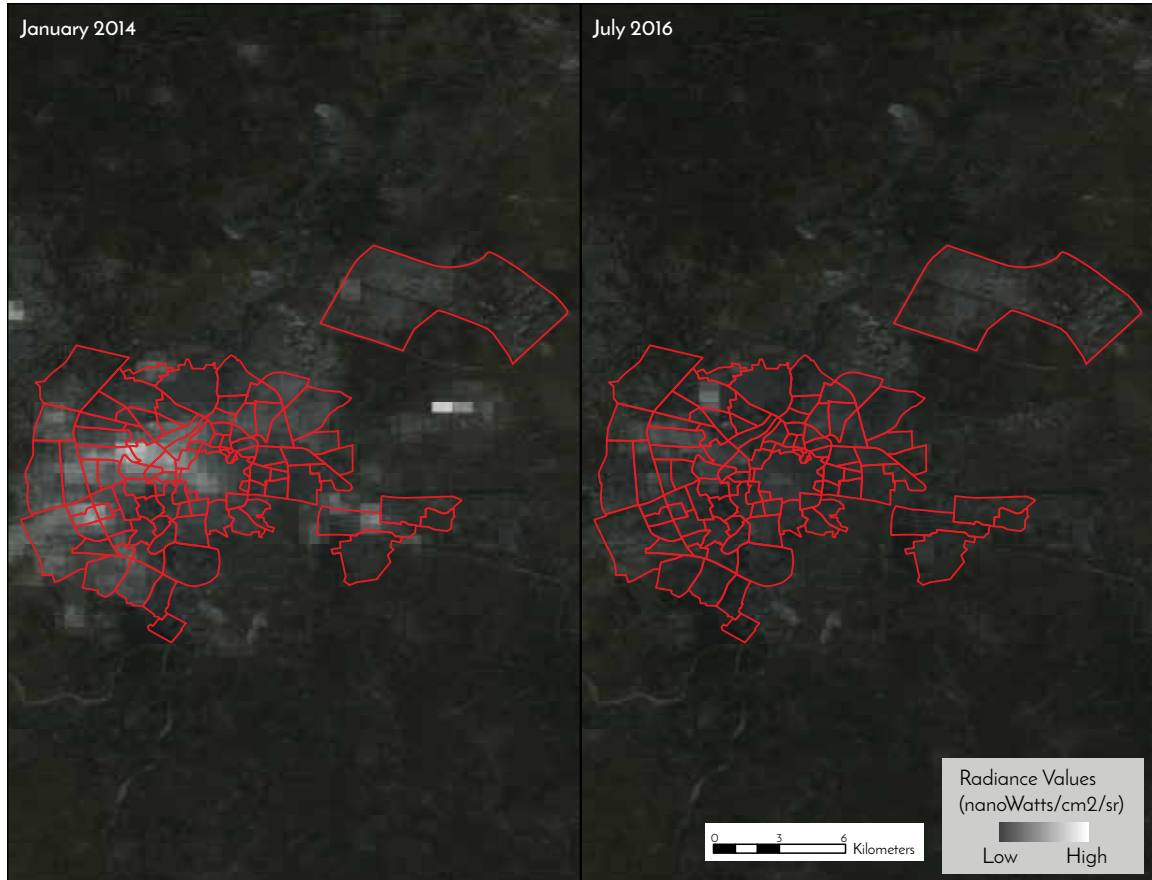


Figure 27: The Image Below Demonstrates the Resilience of the Local Population Under Active Conflict Conditions. Residents Have Cut and Fixed Barrels on Rooftops as Makeshift Windmills



A resident mounts a cut barrel to ensure that it captures wind flow; it is installed on the roof of a building.

Solar Power and Commercial Generators

In the absence of public electricity access, small businesses have sprung up in various parts of the city that either sell solar panels, or provide connection to the commercial generators for a fee. Social media accounts associated with the public electricity company, and local news outlets, suggest that generator networks are far more extensive in western Aleppo neighborhoods than in other parts of the city. According to some reports there are more than 100 commercial generators operating in the city. Similarly, for solar products, one vendor claimed that he sells around 70 Solar panels a day.

Hama

Prior to the Syrian crisis, Hama city residents relied on two local power plants and surplus electricity from the northern and southern power grids to supply the city's public electricity network. In addition to the damage to these facilities, natural gas, diesel, and heavy fuel oil shortages prevent the facilities from operating at full capacity. From March to September 2016, the public power network remained the primary electricity source for the city of Hama. Social media sources, local news outlets, and other public sources suggested that most residential neighborhoods in Hama received between five and nine hours of electricity from the public power grid each day.

Similar to the conditions in Aleppo, a significant population displacement pattern is in effect and there is a very high inflow of people into Hama. Over the course of the Syrian crisis, Hama city has absorbed roughly 500,000 internally displaced people (IDPs), placing significant strain on local infrastructure as well as the resources at the disposal of the public energy sector maintenance and repair staff. Both power generation plants located in Hama Governorate, Al-Zara Power Plant and Mhardeh Power Plant, have sustained damage as a result of conflict in the immediate vicinity and have been designated as 'partially damaged' and partially functioning' at the time of this assessment. This had the effect of significantly reducing the capacity of the public network to meet the electricity supply needs of the city. Hama local government relies upon public outreach campaigns to get the population to conserve electricity. In particular, advertisements and social media posts urge residents to reduce power consumption during peak hours, which generally fall between 7:00 AM to 9:00 AM and 5:00 PM to 10:00 PM.

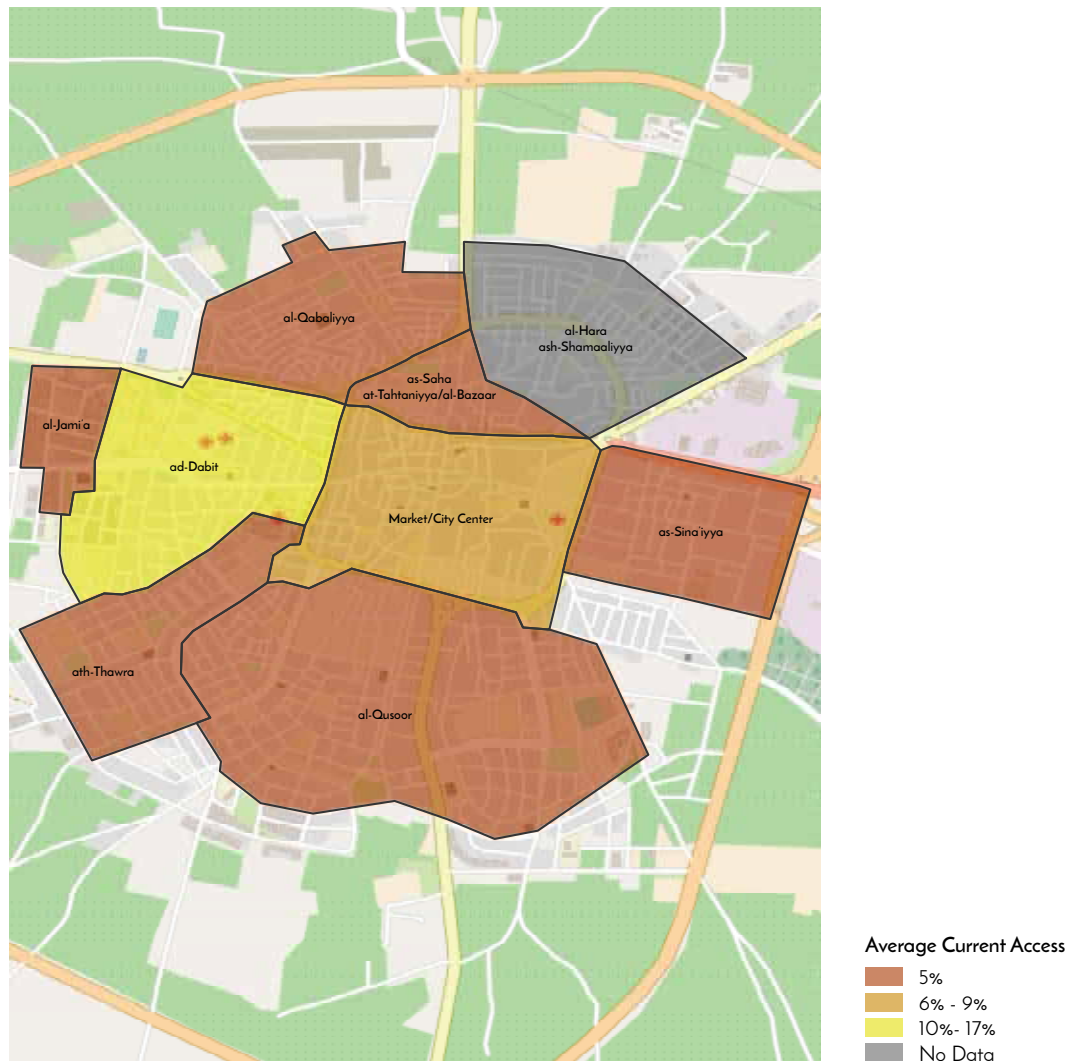
Since at least December 2015, the Hama Public Electricity Company has been engaged in a broad campaign to renovate and upgrade the energy-related infrastructure of Hama city and the surrounding area in an effort to meet the increased energy needs of the city's population. However, the city is not able to cope with increasing demand, frequent damage and technical failures of the network.

Idlib

As of August 2016, the Zayzun Power Plant, which was a vital component of Idlib's energy infrastructure prior to the crisis, had sustained extensive damage and equipment loss as a result of conflict conditions and looting. From March to August 2016, Idlib city's extremely limited access to the public power network necessitated the diversion of electricity reaching the city via the public grid to certain 'humanitarian' priority sites, including hospitals, bakeries, water pumping stations, and telephone exchange stations.

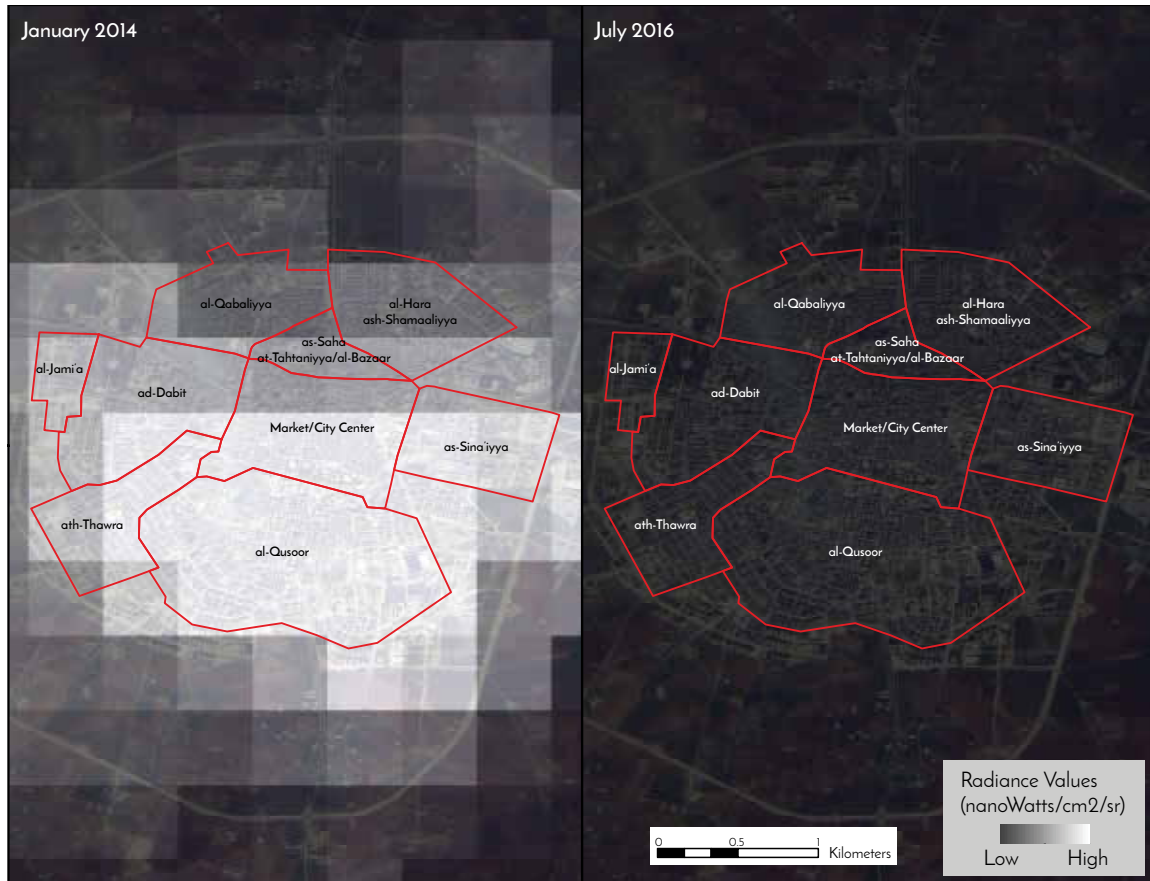
As a result, the amount of power available for residential and commercial use in Idlib from the public network was negligible over this period of time. Residents have turned to alternative power sources, such as large commercial generators, small home generators, and to a lesser extent, solar panels, to satisfy their power needs. Approximately 75 percent of Idlib city households currently rely on commercial or private generators as their primary power source, up from roughly 42 percent in December 2015. Of these households (Dec. 2015), 30 percent paid for subscriptions to commercial generators, while about 12 percent reportedly owned private household generators. The figure below depicts the extremely low level of power availability in different parts of the city through the public network.

Figure 28: Idlib City - Access to Public Network Power (September 2016)



In Idlib also as in the case of Hama, the current efforts to rehabilitate and repair the electricity network are faced with challenges of frequent damage and technical failures. The images below present a comparison of electricity network availability in Idlib between January 2014 and July 2016.

Figure 29: VIIRS Imagery Comparison of Idlib City Lighting, January 2014 and July 2016



EDUCATION

A. Damage Assessment

Evidence on infrastructure damage across the governorates of Aleppo, Hama, and Idlib, suggest significant impacts to education facilities resulting in estimated damages of between **US\$169 and US\$207 million**. Information to corroborate these estimates are generated from satellite imagery, on-the-ground informants, and social media. An estimated 53 percent of education facilities in Aleppo are either partially damaged or fully destroyed. Across all three cities, education facilities were categorized by asset types (Kindergarten, primary school, secondary school, combined primary and secondary school, vocational institutes, colleges or universities, education offices and unknown education facilities) and the level of facility functionality.

All education facilities are functioning in Hama, compared to functionality levels of about **92 percent and 39 percent in Idlib and Aleppo respectively**. Facilities listed as non-functional may have sustained significant infrastructure damages, or may be cut off from a sufficient supply of clean water and power sources, thus rendering the facility unfit for use. Civil society

organizations estimate that functioning schools use as much as 84 percent⁴⁷ of a facility's capacity to operate. Some key features, such as functioning latrines, continue to be intact at 85 percent of functioning schools in Aleppo and 99 percent of schools in Idlib and Hama. Similarly, functioning schools maintain some access to clean drinking water at 87, 98 and 100 percent respectively in Aleppo, Idlib and Hama. In some cases schools are being over-utilized, for instance in Idlib, where the number of students exceeds the capacity of functional schools to absorb them. This stands in contrast to other governorates in the country where schools are highly underutilized due to population displacement and movement.

Educational facilities function, but access is severely restricted. The main impediments to access include: (i) insecurity in traveling to and from school; (ii) fears of being targeted while in schools; (iii) lack of teachers and limited teaching and learning materials; and (iv) a need for children and young people to supplement family income by forgoing education.⁴⁸ Therefore, despite the functionality status of education facilities, the actual usage of the facilities and true level of functionality is likely underreported. Indeed, the services and learning opportunities afforded to students remain limited given the risks associated with the ongoing conflict.

Schools and educational facilities across cities with increased levels of conflict are most susceptible to high rates of student dropouts. Schools in the Idlib and Hama governorates have suffered significant damage due to higher rates of bombing in opposition controlled areas. Students who attend school in those areas are presented with increased risks. Reports also point to the usage of schools as military quarters and informal shelters for displaced community members. Poor access to quality education facilities have led to large-scale student dropout. Across the country, it is estimated that student drop out between 2010/11 and 2014/15⁴⁹ stood at 44 percent and that current gross enrolment rates (GERs) have reached 78 percent, which is significantly lower than the earlier estimates of GER in Syria of 91 percent in 1996.⁵⁰ Cities under heavy siege are estimated to have witnessed exceptional levels of student enrolment losses. In Aleppo for instance, approximately 0.9 million students (in Grades 1 through 9) are no longer enrolled in school. Enrolment losses are prevalent across all levels of education. For instance, kindergarten enrolment in Aleppo has decreased from 19,000 pupils in 2010/11 to only 266 (one per cent of the original level) in 2012/13 and 388 in 2014/15, while 637,000 primary students were pulled out of school in the first two years of the conflict.⁵¹ According to recent estimates, student attendance rates are six percent⁵² in Aleppo, while in Idlib and Hama attendance rates are reportedly much higher. The largest proportion of enrolled students are in primary schools (grades 1-6) with almost equal access levels for female and male students. However, at lower and upper secondary levels female enrolments tend to be higher, possibly due to male students foregoing school for work. It is estimated that this high prevalence of student dropout will result in economic loss of US\$10.67 billion, equivalent to about 17.6 percent of the 2010 Syria GDP.⁵³

47 Assistance Coordination Unite. 2016. Schools in Syria Thematic Report.

48 UNOCHA, September 2016.

49 UNICEF. (2015). *Syria education sector analysis: The effects of the crisis on education in areas controlled by opposition groups, 2010-2015*.

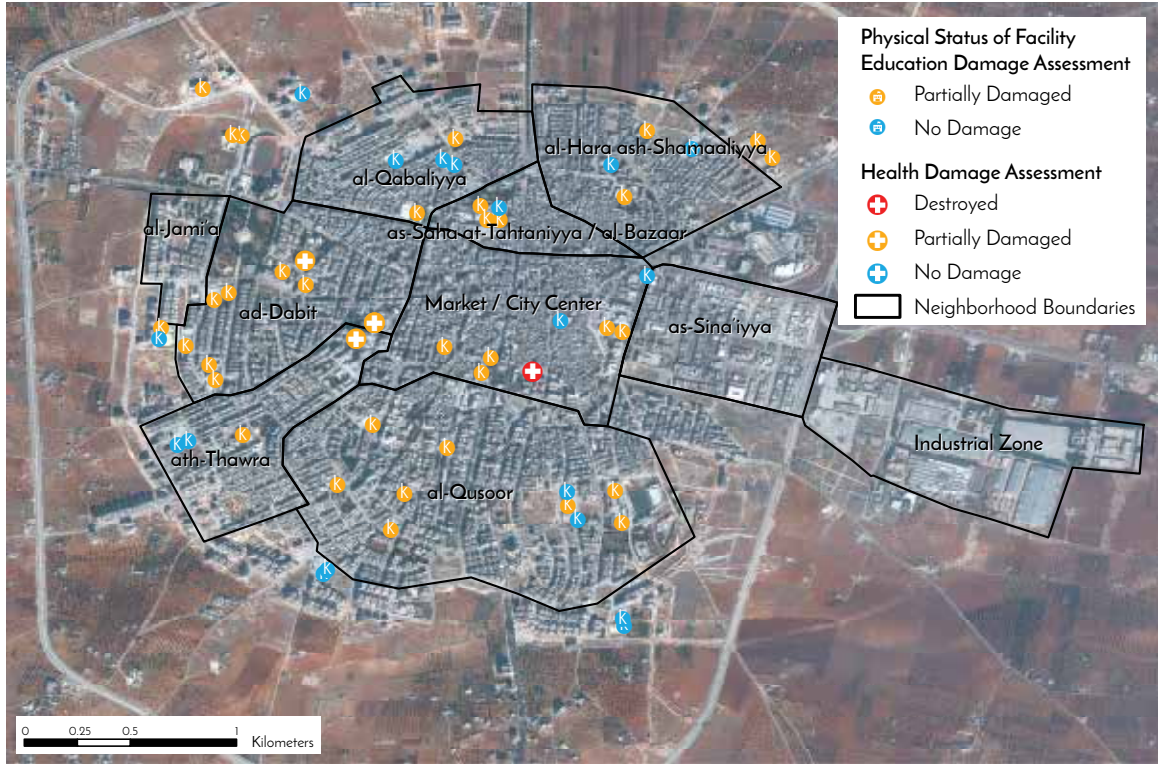
50 Humanitarian Response Plan; January- December 2016. (2016). Syrian Arab Republic. https://www.google.com/?gws_rd=ssl#q=humanitarian+response+plan+syria

51 UNICEF. (2015). *Syria education sector analysis: The effects of the crisis on education in areas controlled by opposition groups, 2010-2015*.

52 <http://www.telegraph.co.uk/news/2016/10/02/new-school-term-starts-in-aleppo-but-few-children-return/>

53 https://docs.unocha.org/sites/dms/Syria/2016_hrp_syrian_arab_republic.pdf

Figure 30: Idlib – Damage to Education and Health Sectors



*Please note that this graphic shows those facilities identified with a high degree of locational accuracy. Facilities only identified by neighborhood or city are not depicted.

Table 15: City-Level Physical Damage Cost Ranges in Education

City	Damage Estimates (Million USD)	
	Low-End Estimate	High-End Estimate
Aleppo	\$157	\$192
Hama	\$1.3	\$1.6
Idlib	\$10	\$13
Total	\$168	\$207

B. Impact on Service Delivery

Schools do not provide a safe and secure learning environment. Damage incurred on schools and the use of schools for alternative functions, for example as detention centers or military bases, have instilled fears for students' safety and protection. Schools have been identified as targets and have been bombed, and students have been pulled from schools and arrested at random. Families thus report security fears as the main reason for students missing school or opting to drop out.

Security concerns and the unpredictability of operating in a conflict area have led to reductions in school hours. Schools are forced to reduce their operating hours not only due to security concerns, but at the same time, may have to introduce a second shift to accommodate the large numbers of new students who have arrived as IDPs. These reductions affect instructional times making it difficult for teachers to complete the curriculum materials especially if the schools experience frequent closures due to security concerns or such problems as lack of electricity or impeded access.

Functioning schools with relatively safe learning conditions are experiencing increases in average student-to-teacher ratios (STRs). A select number of (single shift) schools report STRs exceeding 40 students per classroom.

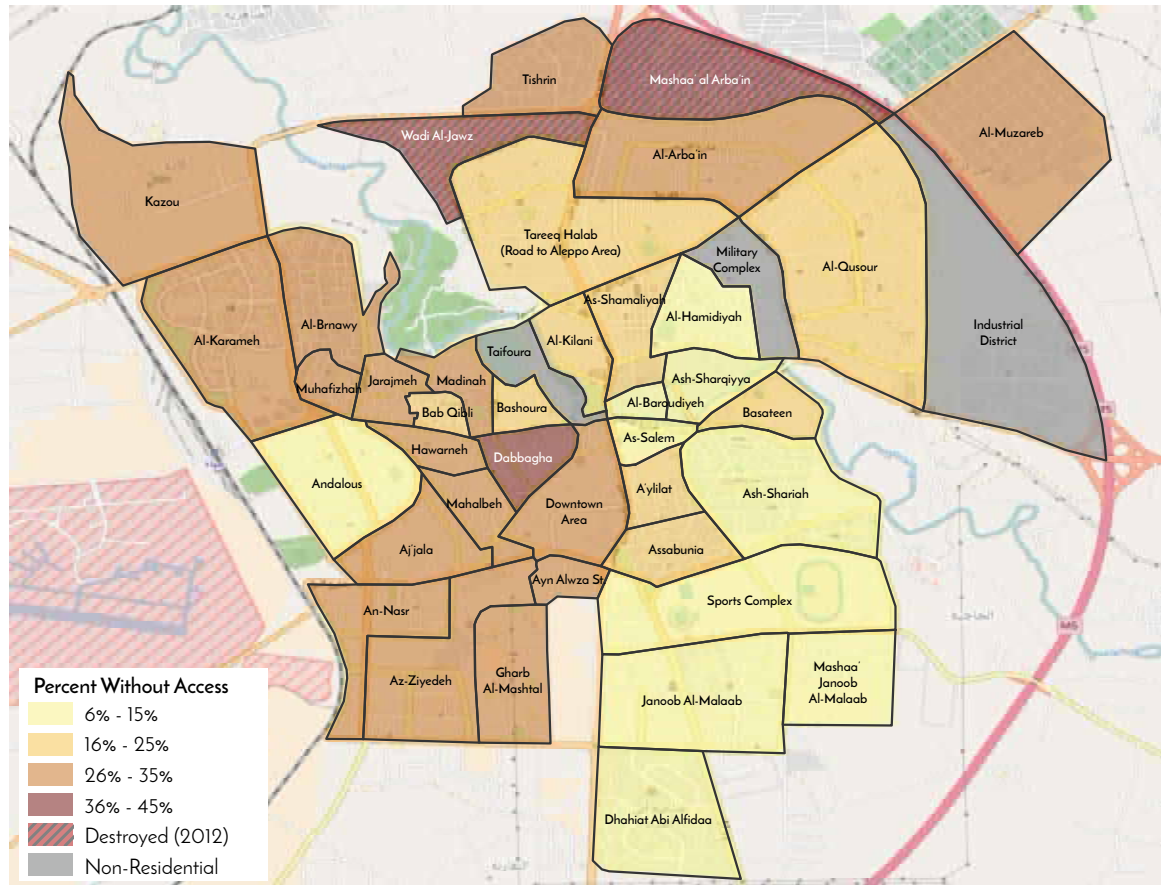
Teachers still fear for their security and personal safety leading to high levels of teacher flight. Estimates from 2013 reveal that 500 education workers were killed across Syria that year while many others were injured, kidnapped or arrested. More recent estimates are harder to verify. Those that have remained feel unprepared to teach under conflict circumstances, while new under-qualified volunteer teachers have entered the profession to fill the void. Teachers report concerns with the stress of teaching in a conflict environment and with the challenges of engaging with their students in such circumstances. Some of their key concerns include: (i) teaching traumatized children; (ii) how to react in an emergency; and (iii) classroom management.

Teacher absenteeism continues, largely due to poor remuneration. Many teachers in rebel-held areas, have not received their monthly salaries, making it difficult for them to sustain a livelihood. In many cases, teachers are required to travel outside of the city passing multiple roadblocks (controlled by both opposition and Syrian Government forces) that "tax" passengers attempting to exit and enter city boundaries. The inadequate and infrequent salary payments drive teachers to take on second jobs that require their attention during school hours. Additionally, the limited availability of teaching and learning materials is also a concern as teachers are unable to instruct students appropriately due to the lack of supplies.

A parallel education system has been established in cities outside of the Syrian Government's control. Students studying curriculum adaptations that are not in-line with the Syrian Ministry of Education (based in Damascus) will not be prepared to take the national high-school assessment and will thus miss out on their opportunity for certification. The modified curriculum is mainly being taught in Idlib and Aleppo.⁵⁴

⁵⁴ Assistance Coordination Unit. 2016. Schools in Syria Thematic Report.

Figure 31: Children Without Access to Educational Facilities in Hama City



WATER SUPPLY AND SANITATION (WASH)

A. Damage Assessment

Characterization of Damage Overview

This study provides a partial perspective on the damage sustained by water infrastructure. The major asset classes under investigation in this study include wells, water tanks/towers, water treatment plants, sewage treatment plant, dams, dike, pumping stations, storage reservoirs, and water and sanitation offices. It was not possible to identify directly the level of damage to piped networks for water distribution, drainage, or sewage because of difficulties in assessing the functionality of sub-surface piped networks through earth observation. The access to the public water network was surveyed in September 2016 in all three cities; the information provided is still qualitative and it is extremely difficult to estimate the extent of damage to the water distribution, drainage, and sewage networks. This is a major source of uncertainty moving forward and once more information are available, a more accurate estimate of network damage and cost would need to be conducted.

Water infrastructure depends on power infrastructure. Water is moved throughout the distribution network by pumping. Pumping requires electricity. The functionality of water services is therefore directly correlated to the status of the electric grid, and the availability of generators and fuel. Lack of electricity was the number one reason for service outages, with damage to pumping stations and piping networks being the second most common reason. Due to this vulnerability, the three cities have developed a back-up plan relying especially on wells during long episodes of public water network outages. For example, in Hama, 60 new wells were developed by the water authority to supply water to the public on a regular basis and during times when the main pipeline is not functioning, as an essential back-up supply. A similar situation was observed in Aleppo and Idlib. More particularly, it was reported that no residents in Aleppo have accessed water via the public network since January 14, 2017. Residents are entirely reliant on the more than 150 public and 300 private wells within the city for their water supply. In addition, some residents have turned to alternative water sources, namely water trucks, to satisfy their daily needs.

In **Aleppo**, there has been both widespread damage to major water infrastructure and major operational stoppages due to shortages of fuel and electricity.

The Al-Khafsa Water Treatment Plant in Aleppo was partially damaged but still functioning due to an airstrike causing some structural damage at both the larger and smaller facilities. It was then put offline for a period of two to three months until resuming full service to the city of Aleppo. Repairs were made by government engineers under the auspices of the Red Crescent and the plant returned to partial service, but was taken out-of-service completely thereafter. No further reporting has indicated that any major damage has occurred to the plant since March 2016. However, pumping from al-Khafsa Plant has been stopped during this period due to power outages and the government is continuing with its emergency plan to supply the city with water from newly equipped wells (around 150 wells) and holding tanks.

Sulayman al-Halabi Pumping Station, is one of two main pumping stations in the city of Aleppo that supplies most northern, western and southern neighborhoods. It was partially damaged and since November 2016, repairs have been underway by government crews on piping, pumps and generators. The station is only partially functioning because of power outages due to the damage to the electrical supply line to the station, coinciding at times with diesel fuel shortages and malfunctions in the generators. In mid-November 2016, a new 2000 KVA generator was supplied to the station, which improved operations.

Bab al-Nayrab Water Pumping Station is the other main pumping station in the city of Aleppo, providing water to the Old City and eastern neighborhoods. As with the other pumping station, its operations have been halted in light of the cut-off of Aleppo from al-Khafsa Station on January 14.

Over the past several months, Bab al-Nayrab has experienced outages mainly due to its electrical power source being cut-off and/or its electrical supply station being bombed. This would also signal that the station does not have sufficient diesel fuel to operate generators in the case of an electrical outage. In early January, repairs were made to a generator, yet malfunctions with these devices could still plague its operations.

The Al-Ramouseh Sewage Treatment Station is Aleppo's main facility for treating wastewater. It has not been damaged and it is functioning. However power outages were reported impacting both collection and treatment.

Figure 32: Bab al-Nayrab Water Pumping Station: Partially Damaged, Partially Functioning

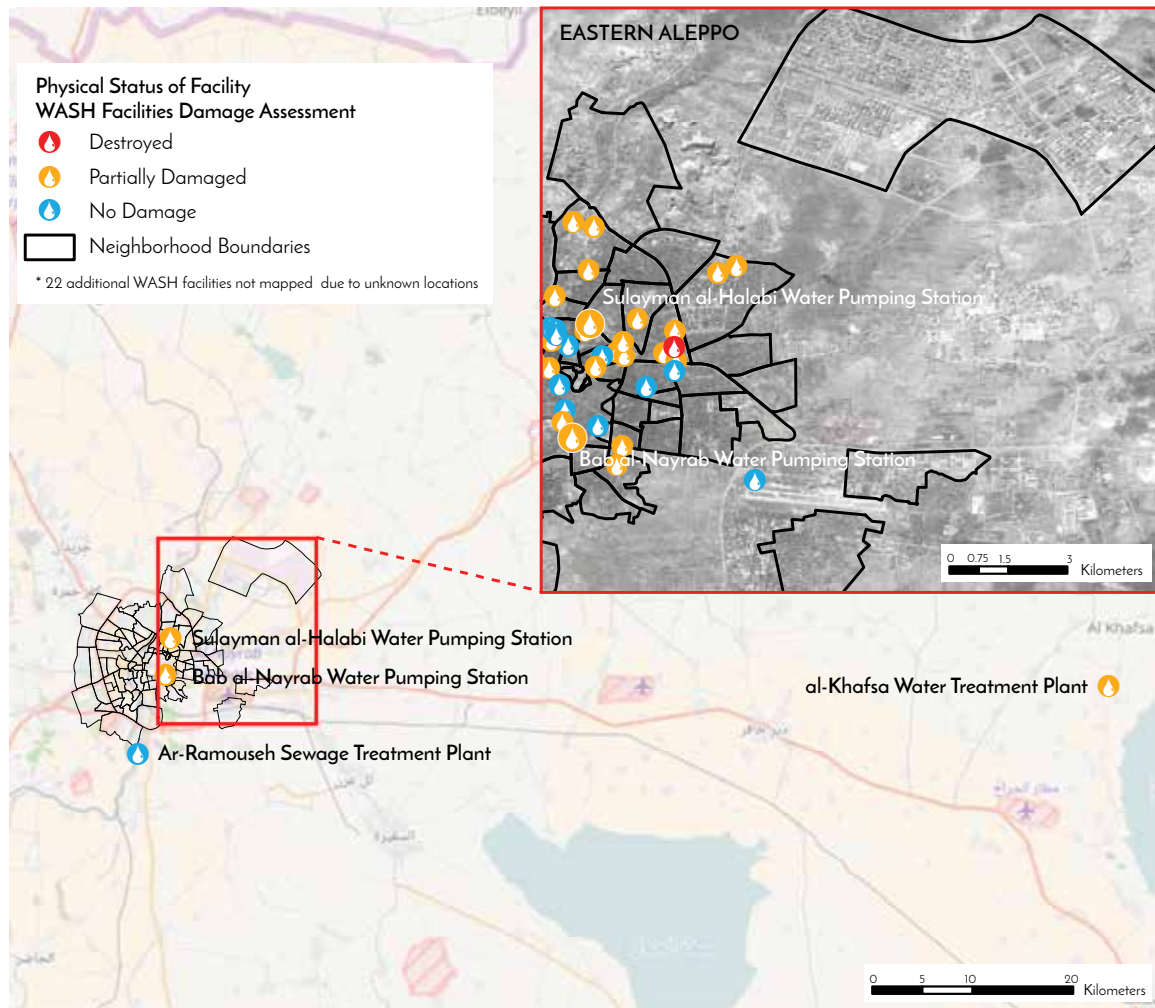


No reporting has indicated that any *water tower or tank* has been damaged in Aleppo but the water piping networks connecting them to pumping stations have seen extensive damage (i.e the case of two big pipelines: (i) a 1.4 m pipeline that connects Sulayman al-Halabi Station to the Tishreen Tower/Tank and, (ii) the pipeline that connects Bab al-Nayrab Station to the Karam al-Jabel Tower/Tank, which supplies water to the Old City). Some repairs were being carried out.

From October 2016, further damage was sustained by the water piping network due to the fierce fighting that occurred as the government wrested control of all parts of the city of Aleppo. From October 2016 to January 2017, repairs were reported being made on pipelines in the following areas, most of which are in eastern and southern areas of the city: Tal'a al-Mashad, al-Mashad, Tariq al-Bab, Duwar Qadi Askar (along the pipeline that connects Bab al-Nayrab Station and Karam al-Jabel Tank), Duwar al-Salahin, al-Muwasalat al-Qadima, Karam Houmed, al-Maysar, Bustan al-Qasr, al-Balat (in the Old City), Karam al-Khasim, al-Kalasa, Masakin al-Fardous, al-Fardous and Duwar al-Sina'a.

This damage caused entire neighborhoods to be cut-off from the public water network and forced households to rely on wells and water trucks until repairs are made. Water from these sources is much more expensive than from the public network i.e the average cost per cubic meter is about US\$12 in Aleppo, US\$10 in Hama and US\$11.81 in Idlib. Well water brings the additional danger of water-borne infections and diseases because well water is reported to be polluted and untreated in many areas of the city. Since the start of the conflict, during normal operations of the pumping stations in Aleppo, residents in all areas of the city have been subject to water rationing and have been only supplied one day every 5-20 days. Along with reports of weak water pressure and shortened periods of water availability, this explains why such high percentages of residents continue to rely on wells and water trucks in the best of times.

Figure 33: WASH Damage in Aleppo as of February 2017



In contrast to Aleppo, no physical damage was reported in Hama and Idlib. The city of Hama's water infrastructure remains largely intact and functioning, although its main supply line, which receives water from the Orontes River at the Syria-Lebanon border area some 80 kilometers away, and its associated pump and treatment stations, are vulnerable to attacks and were put out-of-service for a number of days or weeks several times in 2013 and 2014 due to fighting. Since March 2016, water provision has remained fairly stable and routine for the city of Hama. It does appear that shortages occur from time to time in various neighborhoods but for the most part, the city's residents are regularly supplied with their typical water quota. In September 2016, as the city accepted more internally displaced persons, there was reportedly more pressure on Hama's public water supply. The city has drilled additional wells to increase the water supply to cope with the influx of IDPs.

In Idlib, the main source of water is the Ayn al-Zarqa' Spring. It provides 38 percent of Idlib Governorate with drinking water, including the entire city of Idlib, and is also a primary water source for Idlib's largest irrigation reservoirs. The water is pumped from the spring through the

main water supply transfer source for the city via the Sayjar Water Pumping Station. Water is pumped to this station from 'Ayn al-Zarqa' Spring and from there it is pumped on to the city of Idlib and parts of Idlib countryside via the public network. The water facilities of Idlib are then mainly (i) 'Ayn al-Zarqa' Spring and its pumping station; and (ii) Sayjar Water Pumping Station. The water network remains largely intact and undamaged but repairs, routine maintenance and rehabilitation of the network are needed. Water lines and pumps are likely old, thus causing weak water pressure and leakages. The Water Administration and aid agencies are participating in efforts to improve the network, including the digging of new wells, but these efforts likely also face difficulties with the lack of power and fuel.

Data on household water consumption as of September 2016. Service delivery in Homs was in a similar situation as the three assessed cities, i.e. if the water needs are not covered by the public networks, people mainly rely on water trucks and local wells. Water from the public network in Homs is provided for less than 2 hours per day for more than 50 percent of the people interviewed; 18 percent are receiving water for 2 to 4 hours; and only 3 percent are receiving water 12 to 24 hours. Finally, most households have spent 2 or more consecutive days without water in the last 30 days. Hence, the service delivery for water for Homs is similar to the other cities (Aleppo, Hama and Idlib). 110 households were interviewed in Aleppo, 110 in Homs and 538 in Idlib. The household survey provides information on both the individuals living in the household and the household as a whole, across the WASH sector. For all the three cities, half of the households interviewed were receiving enough water in the previous 30 days to meet their household needs. Around 44 percent of people in Aleppo do not have enough water; 40 percent in Homs and 48 percent in Idlib. People are relying on different sources of water to cover their household needs (i.e. public network; water trucking; closed wells; open wells; springs and bottled water). The main source is the public network, which covered 37 percent of household needs in Aleppo; 44 percent for Homs and 38 percent in Idlib, followed by the water trucking for around 31 percent of needs for all the cities and then water wells. For 1 percent of households, bottled water was considered as one of the main sources, especially in Homs and Idlib.

Quantification of Damage to Assets and Infrastructure

Around 327 WASH infrastructure assets were assessed across the three cities. The main damage reported in table 16 is in Aleppo which has been subject to heavy conflict and bombing. No physical damage was reported in Hama and Idlib.

Around 205 wells were assessed in this phase of the Syria DA. Twenty-two wells were partially destroyed and three completely destroyed. Water towers/tanks sustained damage to about a third of the inventory. 34 out of a total of 110 were damaged. The bulk of water tower/ tanks damage was partial damage with only four completely destroyed in Aleppo.

In Idlib, no damage was observed for the 23 wells. They are partially functioning because of a lack of diesel fuel for their pumps. It is estimated that a well needs 250 liters of fuel to run for 9 hours. In January and February of 2015, before opposition forces took over Idlib and when the city was cut-off from Sayjar Water Pumping Station, the government's water administration dug 10 new wells to supply residents with their water needs.

In Hama, all the 68 wells assessed were intact and functioning. Well water appeared to be the major source of water to the city of Hama. These wells are scattered throughout the city. It is not clear what percentage of the water in the city's public network currently comes from wells. In September 2015, additional well digging was planned for different neighborhoods of Hama to increase the water supply in the public network. Similarly to Idlib, wells in Hama require

pumps that run on diesel fuel. Any shortage of diesel fuel affects their operations. Due to the overexploitation of water wells in Hama, the groundwater became saline which may require a desalination plant in the future and more accurate assessment of the water table.

Table 16: Total Damage Inventory

Asset Type	Number			
	Baseline	Total Damages	Completely Destroyed	Partially Damaged
Well	205	22	3	19
Water Tower/Tank	110	34	4	30
Water Treatment Plant	1	1	0	1
Sewage Treatment Plant	1	0	0	0
Dam	6	0	0	0
Dike	0	0	0	0
Levee	0	0	0	0
Other Drainage Structure	0	0	0	0
Pumping Station	4	2	0	2
Storage Reservoir	0	0	0	0
Water/Sanitation Office	0	0	0	0
Total (February 2017)	327	59	7	52

The six dams reported in Hama and Idlib have not received any physical damage or if so they were repaired. These dams were used for water supply, power generation, and irrigation as per the table 17. Their capacity varies between 3.6 and 228 MCM. As reflected previously with other components of the water supply network, the lack of power and fuel impact pumping at the dams. In addition, the lack of information regarding the capacity of the pumps prevents assessment of the replacement costs, when parts are needed. The information provided in this table is only indicative of the damage and the needs; additional on-ground assessment is needed to have better quantitative understanding on the exact nature and extent of the damage.

Changes in the physical status of water towers, pumping stations and dams since the previous DA show no additional damage to the majority of facilities. The changes in the physical status between the previous DA presented in March 2016 (i.e. covering the period between March 2016 and February 2017 for Aleppo, and until September 2016 for Idlib and Hama) shows that the main additional damage is in Aleppo, with the 22 facilities shown in table 18, 4 water towers completely destroyed as of February 2017, and one water pumping station (i.e. Bab al-Nayrab) partially damaged but operating as of October 2016 with shortages of electricity and diesel fuel. Some repairs took place, which are presented as decreased damage for 3 facilities, i.e. the 2 dams reported in Hama as well as the water tower in Aleppo. No change in the physical status was reported for the remaining total of 302 facilities (i.e. 175 in Aleppo; 97 in Hama and 30 in Idlib).

Table 17: Dam Damage Inventory

City	Dam Name	Status	Capacity (MCM)	Use	Damage
Hama	Qastun	No Damage, Partially Functioning	27 MCM	Irrigation	Pumps have either been destroyed or stolen
Hama	Apamea	Possible Damage, Partially Functioning	27 MCM	Irrigation and Water Supply	Pumps damaged and the motors stolen In July 2016, the dam itself was targeted or hit
Hama	Al-Rastan	No Damage, Functioning	228 MCM	Irrigation and Power Generation	Maintenance undertaken in August 2016 on the mechanical and technical equipment related to the dam's gates, spillways, conveyors and generators
Hama	Muhardeh	No Damage, Functioning	50 MCM	Irrigation and Power Generation	Maintenance work for mechanical and technical equipment started in August 2016
Idlib	Al-Duwaysat	No Damage, Functioning	3.6 MCM	Irrigation and Water Supply	N/A
Idlib	Al-Bale'a	No Damage, Functioning	14.5 MCM	Irrigation and Water Supply	Prior to the conflict, water was pumped from Ayn al-Zarqa spring to the dam. Due to a lack of electricity and lack of report to bombing damage to the pumps, no water is being pumped from Ayn al-Zarqa to Al-Bale'a Dam at this time. The dam's water level is thus much diminished.

Energy costs: Electricity shortages and outages have substantially reduced the amount of time that pumping stations are functioning in Aleppo, Hama and Idlib. These power outages affect both urban water infrastructure and irrigation networks. The major impact of reduced levels of service is a reduction in the amount of time during the day that households have access to electricity and, therefore, to pumped water. Every power outage forces the main pumping stations that supply all quadrants within the city to stop and operations are only resumed if diesel fuel is acquired.

Table 18: Water Change Detection Summary

Facility Type	Change Detection Summary			Physical Status Number
	No. of Facilities with Increased Damage	No. of Facilities with Decreased Damage	No. of Facilities with No Change	Possible New Facility
Well	17	0	188	0
Water Tower/Tank	4	1	105	0
Water Treatment Plant	0	0	1	0
Sewage Treatment Plant	0	0	1	0
Dam	0	2	4	0
Dike	0	0	0	0
Levee	0	0	0	0
Other Drainage Structure	0	0	0	0
Pumping Station	1	0	3	0
Storage Reservoir	0	0	0	0
Water/Sanitation Office	0	0	0	0
Total (February 2017 adjusted)	22	3	302	0

URBAN INSTITUTIONS AND SERVICE PROVISION

A. Local Institutions and Service Provision in the Three Cities

The three examined cities have experienced different contexts in terms of whether they are government or opposition controlled; these different scenarios have direct implications regarding which local institutions are in place. The first and most basic variable is what level of services are provided. This relates directly to institutional capacity, financial stability and the various state and non-state actors involved (i.e. public, private and/or civil society). For example, local councils formed during the period when Eastern Aleppo was under opposition control. Reportedly, Aleppo's opposition-run local council was active in providing services such as sewage, and also carried out surveys to assess residents' access to different services.

The second variable is the approach to carrying out these services. In areas under government control there is more centralized public sector involvement, while in areas under opposition control there are a greater variety of public, private and civil society organizations delivering services. A general lack of central authority characterizes opposition-held areas in addition to signs of resilience and adaptation. For instance, the Education Directorate for areas of Aleppo that fell under opposition control oversaw all schools in principle. Some schools were run by neighborhood councils, religious groups, or aid organizations. In the case of the latter, there was no central authority direction involved. Residents and education officials have reported that schools within the same neighborhood were not necessarily teaching the same curriculum, which makes standardized testing impossible.⁵⁵

55 <http://hibrpress.com/3298> ; <http://www.syriauntold.com/en/2016/02/the-battle-of-school-curricula-2-tampering-with-syrias-future/>; <http://www.enabbaladi.net/archives/74397>

Providing services in Syrian cities raises two kinds of challenges. The first is related to conflict-induced damage to infrastructure used in service provision. The second is population movement between cities and even between neighborhoods within a city, causing the pressure of additional demand that exceeds the capacity to provide services in certain locations.

B. Summary of Current Service Delivery Arrangements by Sector

Housing

- In **Aleppo**, regional and international news reporting from May 2016 stated that local residents were repairing damage to windows and facades, particularly in the Midan, Al-Ziediyeh, Helwaniyeh, and Sha'ar neighborhoods in largely opposition-controlled eastern, central, and southwestern Aleppo. Additionally, October 2016 social media activity indicated teams affiliated with Aleppo City Council were conducting basic repairs to residential structures in government-controlled areas of the Old City neighborhood.
- **Idlib** city's rental prices have decreased, while Hama's prices have increased, likely due to Idlib's comparatively less stable security environment.
- Across **Hama**, rental costs reportedly increased by an average of 28 percent from 2011 to 2016, likely due to the city's relatively stable security environment when compared with neighboring cities and towns.

Health

- The population of **Aleppo** is roughly divided into three groups – those residing in Western Aleppo, who have access to the city's remaining medical facilities; those residing in Eastern Aleppo, who have access to temporary health points, mobile clinics, and a few repaired facilities; and those living in IDP camps on the city's outskirts who only have access to mobile clinics. The Syrian Government's Minister of Health announced in January 2017 that his priority in rebuilding the city's health infrastructure will be to repair and equip the Eye Hospital, which will be turned into a general hospital with an emergency room. The Children's Hospital and Zahi al-Azraq Hospital, which are damaged but not destroyed, will also be repaired and equipped to support service provision to Eastern Aleppo. Once these facilities are functioning, the Ministry of Health will focus on building new clinics and health centers in the neighborhoods of al-Zabdia, al-Sha'ar, al-Ashrafiyya, and al-Khalidiyya.⁵⁶
- The health sector in **Idlib** was able to benefit from the 2016 ceasefire that lasted from February to May, to repair and restock medical facilities. Facilities such as the al-Kindi hospital appear to have been refurbished and restocked with surgical equipment, radiological devices, and medicine. International organizations were able to deliver medicine and generator fuel to various facilities at the time. Since the end of the ceasefire, the condition of medical facilities has rapidly deteriorated.
- Overall capacity in **Hama's** health sector, measured in bed space and surveyed over 16 facilities, has decreased by 10 percent, presumably due to shortages of medicine and key equipment. The shortage of bed space is consistent with government-provided information about the Assad Medical Hospital that indicated an 18 percent decrease in treatments alongside a 19 percent increase in patient consultations. 83 percent of facilities reported

⁵⁶ <http://reliefweb.int/report/syrian-arab-republic/syrian-arab-republic-aleppo-situation-report-no-14-20-january-2017-enar>; https://www.facebook.com/permalink.php?story__fbid=1020950188010719&id=120431521395928; <http://www.sana.sy/?p=492768>

a shortage of medicine to treat tumors. 67 percent reported a shortage of medicines used to treat renal failure, and 50 percent reported a shortage of diabetes medicine. Moreover, 67 percent of facilities reported a shortage of x-ray machines, and 50 percent reported a shortage of MRI machines specifically. These shortages are due to the problems in replacing aging machines and the rising cost of spare parts for repairs.⁵⁷

Transport

- In Western Aleppo, local municipalities are performing basic repair functions to damaged roads and reactivating bus routes that were discontinued over three years ago due to conflict. This was also the case for opposition-affiliated municipal organizations. Local news reporting from November 2015 stated that opposition-affiliated municipal organizations paid approximately US\$3,300 per kilometer to build and pave a primary road in opposition-held neighborhoods. Following the shift in control from opposition groups to government forces, rubble removal started as early as October 2016 and has aided in clearance of several neighborhoods including the old city. The Government of Syria is reported to be slowly restoring some basic infrastructure in Aleppo, including city train service connecting the formerly divided east and west Aleppo, clearing blocked roads, and reportedly re-opening the airport in the near future.⁵⁸
- **Idlib** Municipality and the Services Administration appear to conduct road maintenance and remove rubble from public areas. Meanwhile, the local Idlib City Administrative Council likely coordinates with the Idlib Municipality to remove debris and barriers from the city's roads.
- In **Hama**, approximately five percent of the city's roads are not functioning due to lack of maintenance services rather than conflict-related damage. There are indications that local neighborhood committees and the municipality, which is affiliated with the Hama City Council, are conducting road maintenance and debris removal in all neighborhoods. As of September 2016, it appeared that efforts were focused on rehabilitating and paving streets in the Industrial District neighborhood, which reportedly has one of the highest percentages of non-passable streets in the city.⁵⁹

Energy

- Due to the unreliability of the public network, Aleppo residents have devised innovative methods of procuring electricity for household consumption as well as for business needs. These alternatives include devices harnessing the energy of wind and solar power to produce electricity as well as an extensive network of commercial generators.⁶⁰
- In **Idlib** city, institutions relying on private generators as their primary source of power have access to electricity for more hours per day and on a more consistent basis than facilities that depend upon the public network for power. Unlike the city of Aleppo where the commercial generator network was predominantly privately owned, commercial generators are evenly divided between public and private ownership in Idlib.
- In **Hama** City, reports suggest that all but the destroyed neighborhoods have nearly the same amount (5-9 hours) of access to public network power daily. Syrian government data

57 <http://tinyurl.com/gupcuwq>; <http://archive.tishreen.news.sy/tishreen/public/read/335030>

58 https://twitter.com/It_Syria1/status/765559952983388160; <https://twitter.com/alelam1/status/765543360706834432>

59 <http://hamamc.com>; <https://www.facebook.com/Tasikyhet.Shouhada.Alasi/posts/252169904886315>; <https://www.youtube.com/watch?v=bay91FA5ax4>; <https://www.youtube.com/watch?v=MuyddiOn8jM>; <https://www.youtube.com/watch?v=qORtU73BKY>

60 <http://www.enabbaladi.net/archives/30140>

indicates that major power upgrades have been conducted in Hama city recently, raising capacity significantly in southern and eastern neighborhoods such as near the IDP camp Al-Shariah, as well as northern neighborhoods. Hama local government has also been active in public outreach campaigns through social media asking people to conserve electricity in an effort to reduce the need to ration electrical power provision.

Education

- In **Aleppo**, the recent refugee influx and corresponding population increase in the western part of the city have resulted in overcrowding of the schools, placing a strain on education infrastructure. Private institutions are supporting the education system and reportedly providing better quality and availability, but are too expensive for most residents to afford.⁶¹

In Eastern Aleppo during the period when the opposition was in control, the local council established a revised curriculum and reopened 110 schools in opposition-held areas, which frequently experienced conflict-related disruptions and shortages of students, staff, and materials.⁶² Teachers in Eastern Aleppo were encouraged to join the opposition administration but were required to undergo standardized testing to prove that they had the requisite qualifications and legitimate educational certificates. As the conflict continued, severe infrastructural damage and increased aerial assaults forced students out of formal education facilities and into makeshift schools established underground or in previously destroyed buildings. The Directorate of Education worked to ensure that at least one school remained functional in each neighborhood within its jurisdiction, typically within a 10- to 20-minute walk from students' homes.⁶³ Regime-affiliated sources indicate that 175 schools have been repaired in Western Aleppo as of December 2016.⁶⁴

Publicly available reports indicate that the opposition-affiliated Directorate of Education administered 200 staff and 170,000 students at 600 schools across Aleppo province. As of April 2016, many teachers are managed by the government's education directorate while supervised by the local council.⁶⁵

- Eighty-five percent of **Idlib's** schools remained functional as of September 2016 despite ongoing aerial bombardment and severe infrastructural damage to the city's education sector. Conflict-related damage and security concerns have caused intermittent disruptions to formal and non-formal education activities and a dramatic decline in student and teacher attendance rates.
- In **Hama**, residents estimate that 80 percent of schools are functional and accessible to 78 percent of the city's student population. Despite this, student attendance remains at approximately 65 percent of pre-crisis rates.

61 <https://www.alaraby.co.uk>

62 <https://www.newsdeeply.com/syria/articles/2013/09/15/school-year-begins-in-rebel-held-aleppo>

63 <https://www.newsdeeply.com/syria/articles/2015/05/14/aleppo-teacher-describes-destruction-of-school-and-education-system>

64 <http://www.sasapost.com/strategic-value-of-aleppo/>

65 <http://www.enabbaladi.net/archives/74397>

WASH

- When **Eastern Aleppo** was under opposition control, the opposition-run local council reported in early September 2016 that they were replacing main sewage lines in some areas in Aleppo. This indicated that sewage was being collected in large amounts and was likely sent to a large facility such as Al-Ramouseh. The council also reported on its affiliated social media that it was delivering water by truck to public water tanks in areas not connected to the public network. Since the tanks were public, it is assumed that this water was free for residents.⁶⁶
- In **Idlib**, the water administration continues to dig wells and repair water and wastewater lines in different areas of the city. For example, a large rehabilitation project was conducted by the water administration in Idlib from March to June 2016 in Shaykh ath-Thulth. Old water lines and pipes were replaced, including the main water line, and the water network was extended to unconnected areas and households. Polish Humanitarian Action assisted in this project. Idlib's water administration has continued to struggle with water provision for the city's residents due mainly to power outages and fuel shortages at the water pumping stations.⁶⁷

In September 2016, among water users in various neighborhoods in Idlib, 96 percent stated that 90-100 percent of residents in their neighborhood were covered by the public water network before 2011. At present, only 9 percent of water users report that 90-100 percent of their neighborhood is covered by the public water network, with 25 percent reporting that 80-89 percent of their neighborhood is covered. 18 percent of water users report that only 50-59 percent of the households in their neighborhood are covered by the public water network and 22 percent state that only 40-49 percent of households obtain water from the public network.

A February 2016 report outlines some of the staffing and financial needs of the water administration of Idlib. The report stated that the water administration employed 114 persons.⁶⁸ There are at least 20 employees at a pumping station, and 14 drivers who deliver water to homes in areas of the city where the water network does not reach. In June 2015, a laboratory department was created within the water administration to ensure that water in the networks is properly purified and to test the water supply. Many aid organizations have provided support to Idlib's WASH sector since opposition forces took over the city.

- In **Hama**, reports suggest little variation in piped water access of 6-9 hours daily. However, there appears to be significant variation in the percentage of residents per neighborhood who rely on water trucks and wells for drinking water. Some neighborhoods, especially in the northern part of the city stand out for their reliance on these alternative methods of accessing water. This may be a result of a recently increased population stressing the existing network or an influx of people who do not have access to the network.

66 <https://www.facebook.com/TheLocalCouncilOFAleppoCity1/posts/71116975707505>

67 <https://www.facebook.com/Idlib.management/posts/742723642531645>

68 <https://damasbureau.org/ar/18467>

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