



441 G St. N.W.
Washington, DC 20548

October 18, 2022

The Honorable Robert Menendez
Chairman
Committee on Foreign Relations
United States Senate

Overseas Real Property: State’s Initial Assessment of Natural Hazard Risks Faced by its Posts

Dear Mr. Chairman:

Climate change and increasingly frequent and extreme weather events have caused a surge in global natural disasters over the past 50 years, according to a 2021 report by the World Meteorological Organization.¹ The U.S. Department of State has concluded that natural hazards may pose a threat to the safety and security of its overseas diplomatic assets, consisting of more than 90,000 personnel and properties valued at approximately \$70 billion in over 290 locations.² According to State, the increasing number and severity of natural hazards due to climate change heightens the risk of damage to State’s overseas locations (posts) and real property assets, including the office buildings, support facilities, and staff residences that comprise these posts.

In 2020, State established a Climate Security and Resilience program (CS&R) within State’s Bureau of Overseas Buildings Operations (OBO) to assess natural hazard risk, and proactively facilitate the identification, planning, and implementation of natural hazard adaptation measures at U.S. posts.³ As part of those efforts, OBO assesses a variety of natural hazards expected to affect its posts located in 180 countries.⁴ For example, a recent OBO study found that, from 2021 to 2035, the number of its facilities affected by extreme heat could more than double.⁵ In

¹See World Meteorological Organization, *Atlas of Mortality and Economic Losses from Weather, Climate, and Water Extremes 1970-2019*, WMO-No. 1267 (Geneva: 2021).

²State’s assessment of natural hazards uses the term “natural hazards” to refer to all such hazards, regardless of whether they are attributable to climate change.

³OBO acts as State’s overseas real property manager in acquiring, designing, building, operating, and maintaining the department’s real property assets at U.S. embassies and consulates (posts). OBO’s mission is to provide safe, secure, functional, and resilient facilities that represent the U.S. government to the host nation and support the department’s achievement of U.S. foreign policy objectives abroad.

⁴The eight natural hazards OBO currently considers in its global risk assessment are coastal flooding, riverine flooding, extreme heat, extreme wind, tsunamis, earthquake, landslide, and water stress. OBO is currently investigating others, such as volcano and wildfire, for future inclusion.

⁵See U.S. Department of State, *Application of Mass Timber, Rammed Aggregate Earth, and Climate Security in Diplomatic Buildings* (Washington, D.C.: March 29, 2021).

accordance with Executive Order 14008 of January 2021⁶, State released its Climate Adaptation and Resilience Plan in October of that year. The plan outlines State's goals to improve the resilience⁷ of its personnel, facilities, and operations to future natural hazards.⁸

You asked us to review State's efforts to identify which of its posts are at greatest risk of disruption from the effects of natural hazards. This report describes (1) OBO's assessment of the risks of disruption from natural hazards at its posts, and (2) the methodology OBO used to determine these risks.

To identify which posts OBO determined are facing the greatest risk from natural hazards, we reviewed data provided by OBO on the risks eight hazards pose to each post.⁹ We created an [interactive map](#) showing total risk and the eight natural hazard-specific risks for every post. We also prepared a table listing all 294 posts by percentile of total risk score, from highest to lowest, as of May 2022 (see enclosure I).

To understand the methodology OBO used to assess total risk for each post, we reviewed documentation on the data and approach used by OBO to calculate total and hazard-specific risk scores. In addition, we met with OBO officials to discuss the data available for individual locations on natural hazards and documentation on their approach to calculating risk scores. We will continue to monitor State's efforts to identify and address natural hazard risks to its overseas posts. For a detailed description of OBO's methodology, see enclosure II.

We conducted this performance audit from October 2021 to October 2022 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

As State's overseas property manager, OBO has the lead role in acquiring sites, designing, constructing, operating, and maintaining the embassies, consulates, staff housing, and support facilities that comprise U.S. diplomatic posts. As of fiscal year 2022, OBO is responsible for over 25,000 owned and leased assets at more than 290 posts. These assets include buildings (e.g., chancery and consulate office buildings, office annexes, ambassadorial residences, and U.S. staff housing) and support facilities (e.g., perimeter security walls; utility structures; and

⁶Executive Order on Tackling the Climate Crisis at Home and Abroad, Exec. Order No. 14008, 86 Fed. Reg. 7,619 (Jan. 27, 2021).

⁷State defines "resilience" as the ability to anticipate, prepare for, and adapt to changing natural hazard conditions and withstand, respond to, and recover rapidly from natural hazard related disruptions. U.S. Department of State, *Natural Hazards Risk Assessment for Overseas Asset Portfolio*.

⁸U.S. Department of State, *Climate Adaptation and Resilience Plan*, 2021.

⁹According to OBO, these eight natural hazards were generally measured as follows: **extreme heat** is the average number of days with a heat index above 130 degrees Fahrenheit; **extreme wind** is maximum hourly or peak gust wind speeds above the thresholds of 119 km/hr or 154 km/hr; **water stress** is the ratio of total user withdrawals of water to total renewable supply in a water basin; **riverine flooding** is the measurement of flood depth in meters due to extreme discharge in major river basins; **coastal flooding** is the measurement of extreme high tide and storm surge events in meters; **earthquake** is measured by the seismicity region in which a post is located; **landslide** is the average annual frequency of occurrence of a significant rainfall-triggered or earthquake-triggered landslide occurring within a defined area; and **tsunami** is a measurement of the meters of inundation depth caused by a tsunami.

recreational amenities, such as tennis courts and swimming pools).¹⁰ A typical embassy compound is usually located in urban areas on a roughly 10-acre site. Often, U.S. staff housing is located within close proximity to the embassy, although in some cases staff apartment buildings and ambassadorial residences are located on the embassy compound due to security concerns.

The 2017 hurricane in Cuba is an example of a significant natural hazard that affected a State post (see fig. 1).

Figure 1: Damage to U.S. Embassy Havana, Cuba from Hurricane Irma in 2017



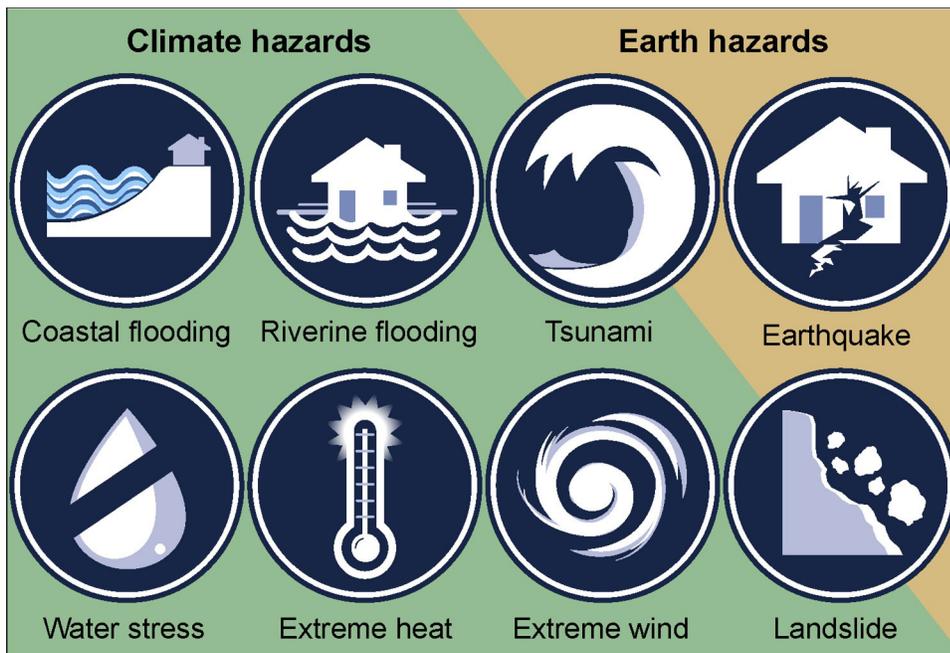
Source: Department of State. | GAO-23-105452

A primary goal of OBO's CS&R program is to determine the risks natural hazards pose to each post. This information helps OBO better understand the magnitude of risks and informs actions to prioritize and address them. Of the eight natural hazards currently assessed by the CS&R program, seven (all except earthquakes) have the potential to be exacerbated by climate change. Three of the eight hazards are earth-related, as illustrated in figure 2.¹¹

¹⁰OBO leases over 16,000 assets through short-term operating leases, largely residences and apartments that house U.S. diplomatic personnel. State covers operations costs (e.g. electrical utilities) on these leases, but the property owners generally complete maintenance

¹¹According to OBO officials, both climate and earth hazards fall within the scope of the CS&R program because earth and climate related events could occur in combination, compounding the effect of each other. For example, an earthquake could be closely followed by a hurricane and high levels of precipitation, further disrupting access to water, shelter, and other basic services. Furthermore, all hazards could pose risks to the safety of State personnel and to property investments.

Figure 2: Natural Hazards Faced by State's Posts



Source: GAO based on Department of State documentation. | GAO-23-105452

State's Climate Adaptation and Resilience Plan outlines priority actions needed to protect the health and safety of personnel and adapt facilities, operations, and mission-critical services to be more resilient to natural hazards. One of these actions is to screen State facilities for hazards to identify those that are most at-risk and require further assessment and intervention. OBO began this process in 2019 and completed a baseline screening for all locations in 2022 by assessing each post's exposure using a variety of global natural hazard source data. OBO also considered the severity of damage from potential hazards and the vulnerability of each post based on its unique characteristics. OBO officials said they will use this screening assessment to determine which posts are at comparatively higher risk. According to OBO officials, they may then choose to evaluate those posts' facilities that are at higher risk for possible mitigation efforts. State officials told us that this risk assessment is iterative in nature and that they intend to continue to refine and update the assessment.

State's Assessment Suggests that Half of Posts at Higher Risk to Natural Hazards are Located in East Asia and the Pacific

As of May 2022, OBO completed an initial assessment of its 294 posts around the world in terms of the potential risk posed by natural hazards.¹² Table 1 shows the 32 posts in the top 10 percent of total risk scores.¹³

Table 1: Department of State Posts Within the Top Ten Percent of Total Risk Scores for Natural Hazards as of May 2022, by Region

Sub-Saharan Africa	East Asia and the Pacific	Europe and Eurasia	Near East	South and Central Asia	Western Hemisphere
None	Apia, Samoa	Izmir, Turkey	Baghdad, Iraq	Islamabad, Pakistan	Guatemala City, Guatemala
	Bangkok, Thailand	Valletta, Malta	Beirut, Lebanon	Kabul, Afghanistan ^b	Havana, Cuba
	Beijing, China		Cairo, Egypt	Karachi, Pakistan	Managua, Nicaragua
	Fukuoka, Japan		Muscat, Oman		Mazatlan, Mexico
	Guangzhou, China				Mexico City, Mexico
	Honiara, Solomon Islands				Port au Prince, Haiti
	Jakarta, Indonesia				San Salvador, El Salvador
	Kaohsiung, Taiwan ^a				
	Manila, Philippines				
	Nagoya, Japan				

¹²The risks calculated by OBO do not take into account (1) city or regional mitigation measures completed, under construction, or planned by host locales; or (2) risk-mitigating projects completed, under construction, or planned by OBO.

¹³OBO calculated the risk levels as represented by data provided to GAO in May 2022 for each post. State categorized these risk scores based on percentiles. Scores in the 90th percentile are at highest risk. This table includes posts whose total risk scores match those that State categorized in the 90th percentile.

Nay Pyi Taw,
Myanmar

Osaka-Kobe, Japan

Port Moresby, Papua
New Guinea

Seoul, South Korea

Taipei, Taiwan^a

Tokyo, Japan

Source: GAO based on Department of State data. | GAO-23-105452

^aThe American Institute in Taipei and American Institute Branch Office in Kaohsiung provide services to U.S. citizens and visas to Taiwan nationals similar to services provided by State at U.S. embassies and consulates in other countries.

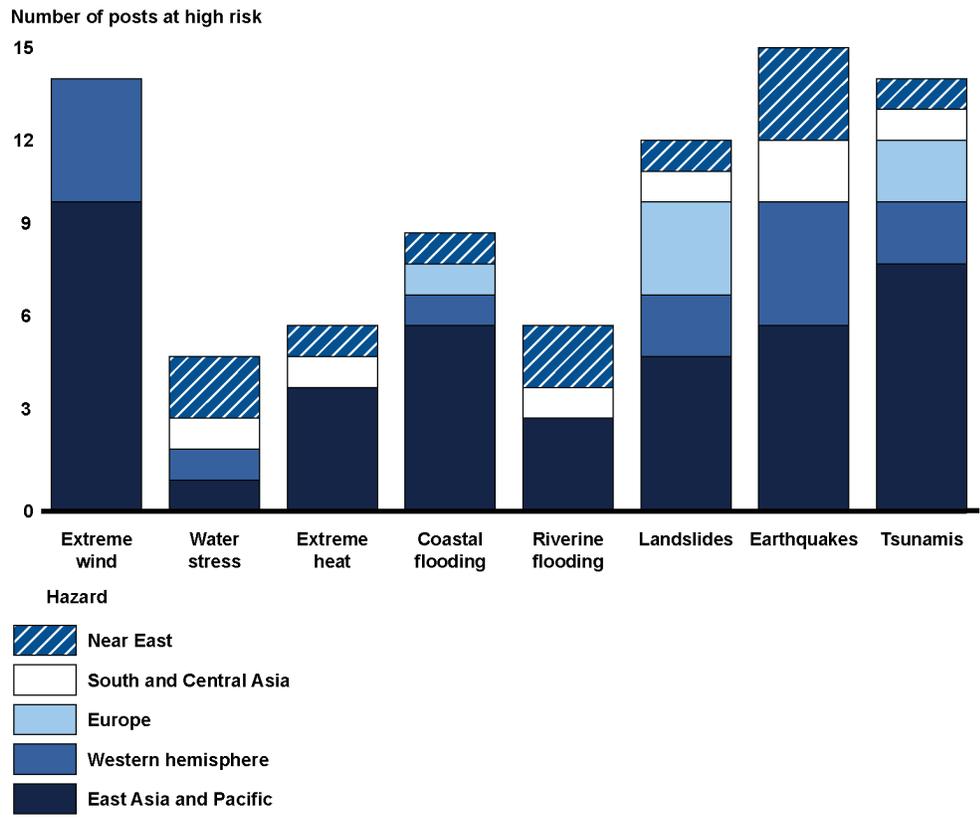
^bAccording to agency officials, State established a Protecting Power “Caretaker” arrangement with Qatar, effective December 31, 2021, to monitor U.S. facilities and provide information regarding the Kabul embassy compound.

Notes: State organizes the countries and areas in which it operates into six geographical regions, each corresponding to one of its six regional bureaus. The six regions are Sub-Saharan Africa, East Asia and the Pacific, Europe and Eurasia, Near East (Middle East and Northern Africa), South and Central Asia, and the Western Hemisphere.

For a listing of all 294 posts identified by percentile of total risk score, from highest to lowest, as of May 2022, see enclosure I. For more information and an interactive map depicting the post locations and risk, see GAO-23-105452. State officials told us that this initial risk assessment is iterative in nature and that they intend to continue to refine and update the assessment.

As shown in table 1, half, or 16, of the posts within the top 10 percent of total risk scores are in the East Asia and the Pacific region. Conversely, the data show that no posts in sub-Saharan Africa are in the highest total risk category. Further, for the 32 posts within the top ten percent of total risk scores for natural hazards, the data show that those in the East Asia and the Pacific region are at high risk across more types of natural hazards, relative to other regions (see fig. 3).

Figure 3: Highest Risk Natural Hazards Faced by Department of State Posts Within the Top Ten Percent of Total Risk Scores, as of May 2022, by Region



Source: GAO based on Department of State documentation. | GAO-23-105452

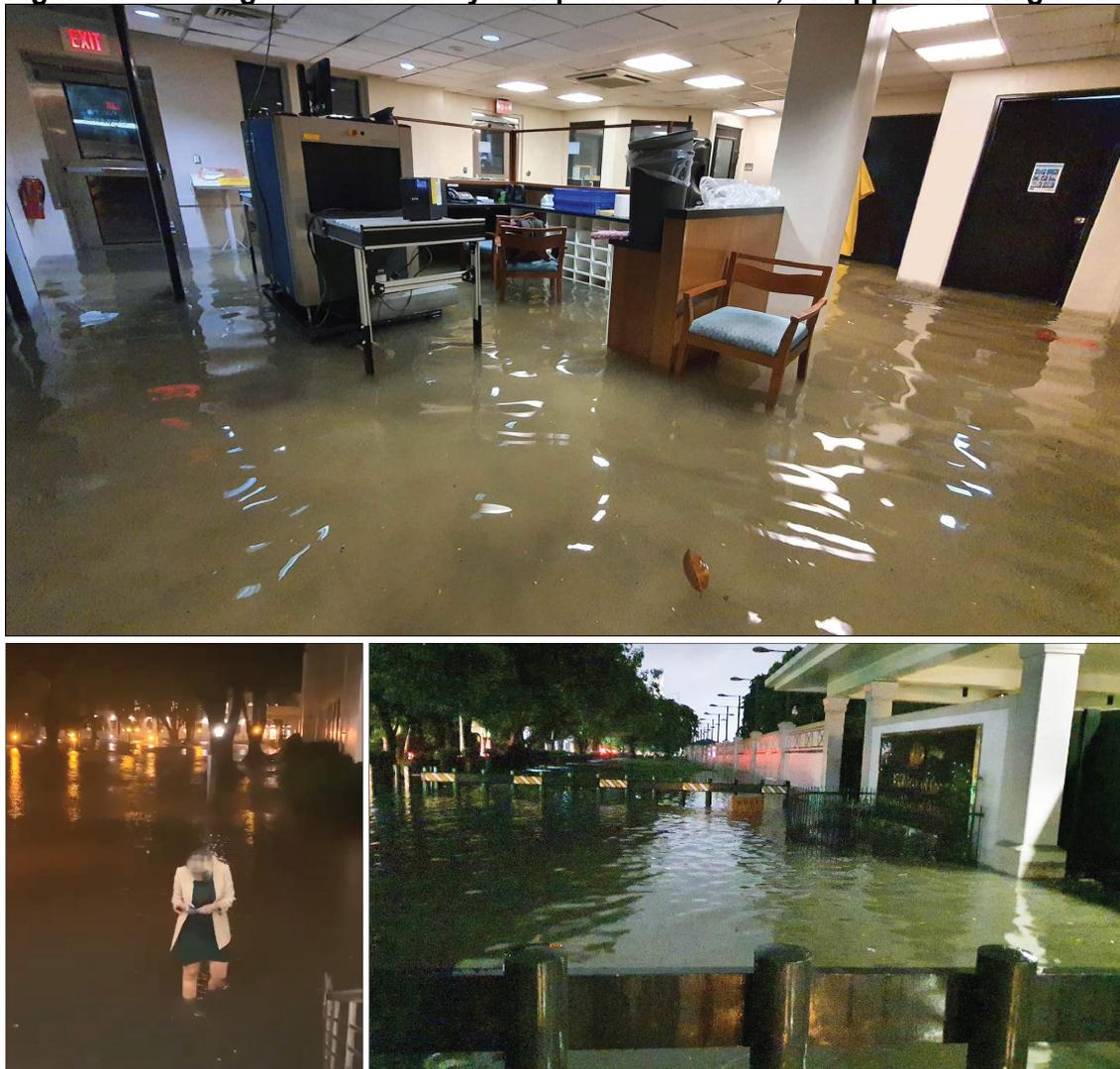
Note: The figure represents the highest risk natural hazards faced by the 32 posts that are in the highest percentile group for total risk. Some posts may face high risk for multiple hazards.

State organizes the countries and areas in which it operates in six geographical regions, each corresponding to one of its six regional bureaus. The six regions are Sub-Saharan Africa, East Asia and the Pacific, Europe and Eurasia, Near East (Middle East and Northern Africa), South and Central Asia, and the Western Hemisphere.

No posts located in the Sub-Saharan Africa region fell within the top 10 percent of total risk scores.

Of note, the data suggest that the U.S. embassy in Manila, Philippines is the post at highest risk of natural hazards. The Manila embassy, located on the coast of Manila Bay, experienced significant flooding in 2012 following a typhoon. In July 2022, post officials reported that a magnitude 7 earthquake occurred on the northern Philippine island of Luzon, and embassy staff located in Manila experienced tremors. In August 2022, the embassy in Manila was flooded due to heavy rainfall, as shown in figure 4.

Figure 4: Flooding of US. Embassy Compound in Manila, Philippines in August 2022



Source: Department of State. | GAO-23-105452

OBO Considered Natural Hazard Exposure, Potential Severity of Damage, and Posts' Vulnerabilities to Determine Risk

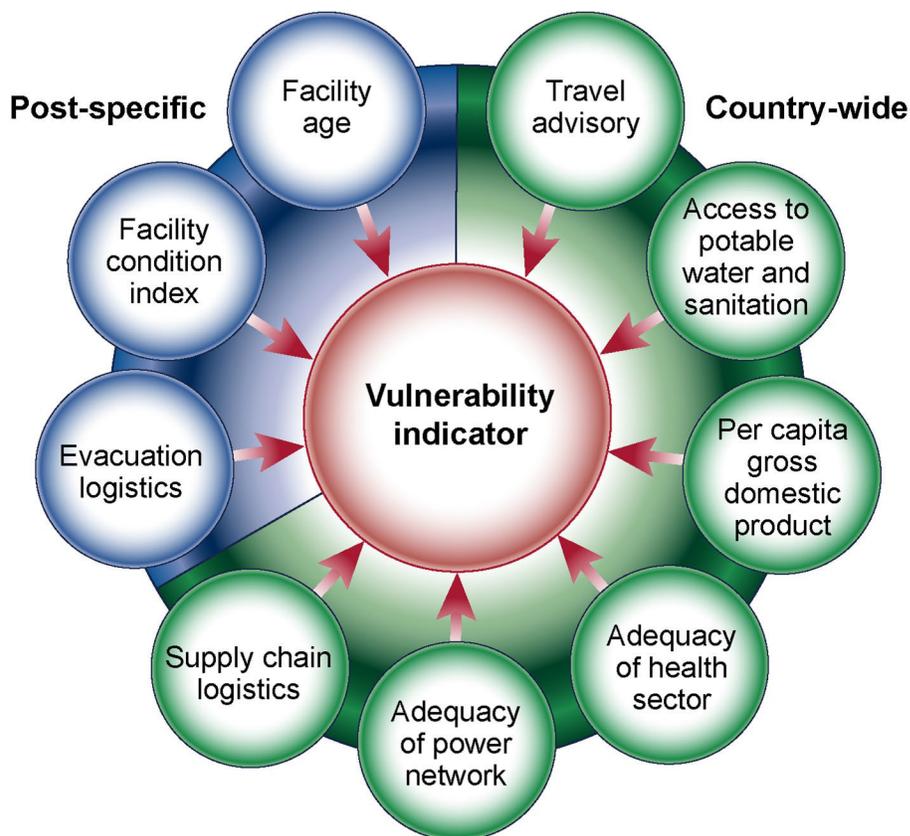
OBO used a variety of data to determine the extent to which its posts are at risk of disruption from natural hazards. OBO's determination of risk first considered data on post exposure to each of the hazards. The data on exposure for each of the natural hazards comes from a variety of public and non-public sources, which include wind data from the National Aeronautics and Space Administration, internal OBO seismic data, and land elevation data based on OBO's review and analysis of data developed by the U.S. Geological Survey.¹⁴

¹⁴Certain limitations exist to data collected and utilized by OBO for use in its risk assessment. For example, exposure data for natural hazards differed in years for which data was available. For a description of these limitations, see enclosure II.

OBO then factored in data to weigh the potential severity of damage in fatalities and financial impact if a hazard were to occur.¹⁵ OBO used post-specific information on mission significance, the number of personnel and families, and the replacement value of the facilities to estimate the impact of each hazard at each post.¹⁶ For example, a post with a low number of staff and a low facilities replacement value could represent a lower risk from a hazard than a post having the same exposure but with more staff and a higher facility replacement value.

OBO’s risk assessment is further influenced by other conditions that may make a post more or less vulnerable to hazards. As shown in figure 5, these vulnerability factors may be post-specific, including the age and condition of the facilities at the post or the ease of evacuation following a hazard; or country-wide, such as adequacy of the power network and health sector, or access to potable water and sanitation.

Figure 5: Vulnerability Factors State Used to Conduct its 2022 Natural Hazard Risk Assessment of Posts



Source: GAO based on Department of State documentation. | GAO-23-105452

¹⁵According to OBO officials, the office used data from the Centre for Research on the Epidemiology of Disasters in Brussels, which provides an objective basis for vulnerability assessment in disaster situations. For example, the Centre helps policymakers identify the disaster types that are most common in a given country and that have had significant historical impacts on human populations.

¹⁶OBO defines replacement value as the cost to design and construct, or acquire, an asset to replace an existing asset of the same functionality and size, and in the same location using current costs, building codes, and standards.

Assessing a post's vulnerability means, for example, that a post where evacuation would be comparatively more difficult may have a higher vulnerability indicator than otherwise similar posts, contributing to a higher risk score. The post-specific data are generated by State, while the country-wide data comes from a variety of sources, including the Global Health Security Index and the World Bank.¹⁷

Because OBO's methodology accounts for exposure, severity, and vulnerability in calculating final risk scores for posts, the presence of a high hazard exposure does not necessarily mean OBO determined a post is at high risk relative to other posts, because post-specific conditions may indicate low impact or susceptibility to that hazard. For example, if a post is located near a coast but comprises newer facilities with ample access to critical services, OBO could score the post lower than a post with comparable exposure to coastal flooding, but has older facilities and less reliable access to critical services. Conversely, a post with a relatively low exposure to natural hazards could get a high total risk score if the post is located in an area with very poor infrastructure and lack of access to critical services. To learn more about the data and methodology used for OBO's risk calculations, see enclosure II.

Agency Comments

We provided a draft of this report and interactive graphic for review and comment to the Department of State. We received written comments from State that are reprinted in enclosure III. We also received technical comments from State, which we incorporated as appropriate.

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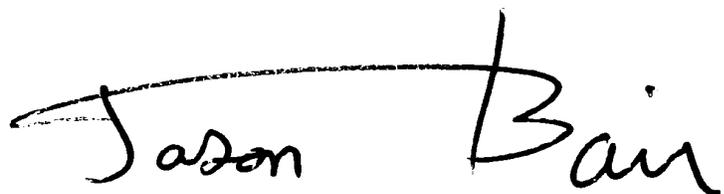
As agreed with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to appropriate congressional committees and the Secretary of State. In addition, the report will be available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff have any questions concerning this report, please contact either Jason Bair at (202) 512-6681 or by e-mail at bairj@gao.gov or Catina Latham at (312) 220-7628 or at lathamc@gao.gov. Contact points for our Office of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this

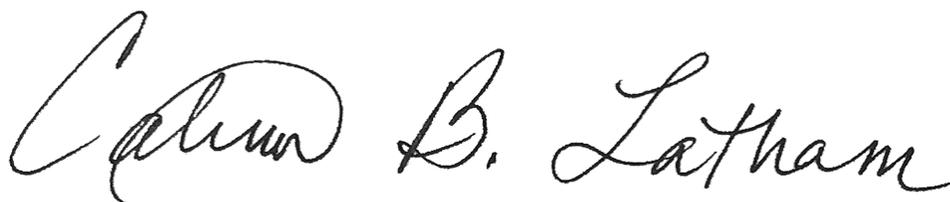
¹⁷The Global Health Security (GHS) Index is an assessment and benchmarking of health security and related capabilities across 195 countries. The GHS Index, developed in partnership by the Nuclear Threat Initiative and the Johns Hopkins Center for Health Security at the Bloomberg School of Public Health, working with Economist Impact, was first launched in October 2019.

report were Leslie Holen (Assistant Director), Mike Armes (Assistant Director), Julia Jebo Grant (Analyst-in-Charge), Katie Bassion, Aida Woldu, John Bauckman, Gina Hoover, Jim Rice, Mark Dowling, Gabe Nelson, Neil Doherty, and Larissa Barrett.

Sincerely yours,

A handwritten signature in black ink that reads "Jason Bair". The signature is written in a cursive style with a long horizontal stroke over the first part of the name.

Jason Bair
Director, International Affairs and Trade

A handwritten signature in black ink that reads "Catina B. Latham". The signature is written in a cursive style with a large, looped initial "C".

Catina Latham
Acting Director, Physical Infrastructure

Enclosures – 3

Enclosure I

Department of State Natural Hazard Risk Data for Individual Posts by Percentile Group, as of May 2022

This enclosure lists all 294 posts identified by State and represented within our [interactive map](#). Table 2 shows the posts grouped into six percentile categories, based on their aggregated risk score across the eight natural hazards assessed by State (total risk). The 90th percentile and above category identifies posts with the greatest total risk scores and 10th percentile category identifies posts with the lowest total risk scores, as of May 2022. State officials told us that this initial risk assessment is iterative in nature and that they intend to continue to refine and update the assessment.

Table 2: State Natural Hazard Risk Data for Individual Posts by Percentile Group, as of May 2022

Percentile Group	Post Location: (City, Country)		
90 th +	Apia, Samoa	Baghdad, Iraq ^a	Bangkok, Thailand
	Beijing, China ^a	Beirut, Lebanon	Cairo, Egypt
	Fukuoka, Japan	Guangzhou, China ^a	Guatemala City, Guatemala
	Havana, Cuba	Honiara, Solomon Islands	Islamabad, Pakistan ^a
	Izmir, Turkey	Jakarta, Indonesia ^a	Kabul, Afghanistan ^a
	Kaohsiung, Taiwan ^e	Karachi, Pakistan ^a	Manila, Philippines
	Managua, Nicaragua ^a	Mexico City, Mexico	Mazatlan, Mexico
	Muscat, Oman	Nagoya, Japan	Nay Pyi Taw, Myanmar
	Osaka-Kobe, Japan	Port au Prince, Haiti ^a	Port Moresby, Papua New Guinea

	San Salvador, El Salvador	Seoul, South Korea	Taipei, Taiwan ^{a,e}
	Tokyo, Japan	Valletta, Malta ^a	
75 th – 89 th	Algiers, Algeria ^a	Antananarivo, Madagascar ^a	Baku, Azerbaijan
	Berlin, Germany ^a	Caracas, Venezuela	Chennai, India
	Chiang Mai, Thailand	Ciudad Juarez, Mexico ^a	Colombo, Sri Lanka
	Dakar, Senegal ^a	Dhaka, Bangladesh	Dili, Timor-Leste
	Dushanbe, Tajikistan ^a	Erbil, Iraq	Guadalajara, Mexico
	Hanoi, Vietnam	Hermosillo, Mexico	Hong Kong, China
	Juba, South Sudan	Kathmandu, Nepal ^a	Kingston, Jamaica ^a
	Kolonia, Micronesia ^a	Kuala Lumpur, Malaysia	Lahore, Pakistan
	Lilongwe, Malawi	Maputo, Mozambique ^a	Mbabane, Eswatini ^a
	Nairobi, Kenya ^a	Naples, Italy	Nuevo Laredo, Mexico ^a
	Peshawar, Pakistan	Phnom Penh, Cambodia ^a	Port Louis, Mauritius
	Port of Spain, Trinidad and Tobago	Rangoon, Myanmar ^a	Santo Domingo, Dominican Republic ^a
	Sapporo, Japan	Seville, Spain	Shanghai, China

	Tegucigalpa, Honduras	Tunis, Tunisia ^a	Vientiane, Laos ^a
	Yerevan, Armenia ^a		
50 th -74 th	Abu Dhabi, United Arab Emirates ^a	Abuja, Nigeria ^a	Accra, Ghana ^a
	Amman, Jordan	Ankara, Turkey	Athens, Greece
	Bangui, Central African Republic	Barranquilla, Colombia	Belgrade, Serbia ^a
	Bishkek, Kyrgyzstan ^a	Bridgetown, Barbados ^a	Budapest, Hungary
	Busan, South Korea	Cancun, Mexico	Cartagena, Colombia
	Cebu, Philippines	Willemstad, Curacao	Damascus, Syria
	Djibouti, Djibouti ^a	Dubai, United Arab Emirates ^a	Florence, Italy
	Fort de France, Martinique	Frankfurt, Germany	Guayaquil, Ecuador ^a
	Ho Chi Minh City, Vietnam	Hyderabad, India	Istanbul, Turkey ^a
	Kampala, Uganda ^a	Khartoum, Sudan ^a	Kinshasa, Democratic Republic of the Congo
	Kolkata, India	Koror, Palau ^a	Lagos, Nigeria
	Lima, Peru	Matamoros, Mexico ^a	Merida, Mexico
	Mogadishu, Somalia	Monterrey, Mexico ^a	Mumbai, India ^a

Naha, Japan	N'Djamena, Chad ^a	New Delhi, India
Nicosia, Cyprus	Nouakchott, Mauritania ^a	Ouagadougou, Burkina Faso ^a
Panama City, Panama ^a	Paris, France	Perth, Australia
Pretoria, South Africa	Pristina, Kosovo ^a	Podgorica, Montenegro
Recife, Brazil	Rome, Italy	Rome, Italy ^b
Sanaa, Yemen	San Jose, Costa Rica	Santiago, Chile
Sao Paulo, Brazil ^a	Shenyang, China	St. Georges, Grenada
St. Johns, Antigua and Barbuda	Surabaya, Indonesia ^a	Suva, Fiji ^a
Tangier, Morocco	Tashkent, Uzbekistan ^a	Tbilisi, Georgia ^a
Tel Aviv, Israel	Thessaloniki, Greece	Tijuana, Mexico ^a
Tirana, Albania	Udon, Thailand	Wellington, New Zealand
Wuhan, China		
25 th -49 th	Abidjan, Cote d'Ivoire ^a	Adana, Turkey
		Addis Ababa, Ethiopia ^a
	Almaty, Kazakhstan	Ashgabat, Turkmenistan
		Asmara, Eritrea
	Auckland, New Zealand	Bali, Indonesia
		Bamako, Mali ^a

Bandar Seri Begawan, Brunei ^a	Banja Luka, Bosnia and Herzegovina	Basrah, Iraq
Belmopan, Belize ^a	Bogota, Colombia	Brasilia, Brazil
Bratislava, Slovakia	Brussels, Belgium	Bucharest, Romania ^a
Bujumbura, Burundi ^a	Cape Town, South Africa ^a	Casablanca, Morocco
Chengdu, China	Dar es Salaam, Tanzania ^a	Dhahran, Saudi Arabia
Freetown, Sierra Leone ^a	Gaborone, Botswana	Genoa, Italy
Halifax, Canada	Hamilton, Bermuda	Jeddah, Saudi Arabia ^a
Jerusalem, Israel	Johannesburg, South Africa ^a	La Paz, Bolivia
London, United Kingdom ^a	Luxembourg, Luxembourg	Lyon, France
Madrid, Spain	Majuro, Marshall Islands	Manama, Bahrain
Marseille, France	Maseru, Lesotho	Medan, Indonesia
Melbourne, Australia	Minsk, Belarus	Monrovia, Liberia ^a
Montevideo, Uruguay	Montréal, Canada	Moscow, Russia
Nassau, Bahamas	Niamey, Niger ^a	Nogales, Mexico
Ottawa, Canada	Palermo, Italy	Palma De Mallorca, Spain

	Paramaribo, Suriname ^a	Ponta Delgada, Portugal	Quebec, Canada
	Quito, Ecuador ^a	Rio De Janeiro, Brazil	Riyadh, Saudi Arabia
	Sarajevo, Bosnia and Herzegovina ^a	Skopje, North Macedonia ^a	Sofia, Bulgaria ^a
	Tripoli, Libya	Vancouver, Canada	Vatican City, Holy See
	Vienna, Austria	Vilnius, Lithuania	Vladivostok, Russia
	Windhoek, Namibia	Yaounde, Cameroon ^a	Yokohama, Japan
10 th - 24 th	Asuncion, Paraguay	Barcelona, Spain	Belo Horizonte, Brazil
	Bern, Switzerland	Bissau, Guinea-Bissau	Bordeaux, France
	Brazzaville, Congo ^a	Buenos Aires, Argentina	Canberra, Australia
	Chisinau, Moldova	Conakry, Guinea ^a	Cotonou, Benin ^a
	Cusco, Peru	Douala, Cameroon	Durban, South Africa
	Geneva, Switzerland	Georgetown, Guyana	Harare, Zimbabwe ^a
	Kuwait, Kuwait	Kyiv, Ukraine ^a	Leipzig, Germany
	Lisbon, Portugal	Ljubljana, Slovenia	Lome, Togo ^a
	Luanda, Angola ^a	Lusaka, Zambia ^a	Montréal, Canada ^c

	Mostar, Bosnia and Herzegovina	Munich, Germany	Nur-Sultan, Kazakhstan ^a
	Porto Alegre, Brazil	Prague, Czech Republic	Rabat, Morocco ^a
	Rennes, France	Reykjavik, Iceland	Singapore, Singapore
	Sydney, Australia	Tallinn, Estonia	The Hague, Netherlands ^a
	Ulaanbaatar, Mongolia	Victoria, Seychelles	Yekaterinburg, Russia
	Zagreb, Croatia ^a	Zurich, Switzerland	
0-10 th	Amsterdam, Netherlands	Banjul, The Gambia	Belfast, United Kingdom
	Calgary, Canada	Copenhagen, Denmark	Doha, Qatar
	Dublin, Ireland	Dusseldorf, Germany	Edinburgh, United Kingdom
	Hamburg, Germany	Helsinki, Finland	Kigali, Rwanda
	Krakow, Poland	Las Palmas, Spain	Libreville, Gabon ^a
	Malabo, Equatorial Guinea ^a	Milan, Italy	Nuuk, Greenland
	Oslo, Norway ^a	Paris, France ^d	Poznan, Poland
	Praia, Cabo Verde	Riga, Latvia ^a	St. Petersburg, Russia
	Stockholm, Sweden	Strasbourg, France	Toronto, Canada

Valencia, Spain

Warsaw, Poland

Winnipeg, Canada

Source: GAO based on Department of State documentation. | GAO-23-105452

Note: The list of State overseas missions is derived from the Bureau of Overseas Building Operations (OBO) real property database. According to OBO, the term “post” refers only to properties in which State has real property interest and is not intended to imply operational status or purpose of a particular property. US missions to international organizations are listed when the overseas mission includes properties that are distinct from the primary State post in that location. When the primary State post and the mission to an international organization have shared assets (e.g. a shared residential complex), the assets are all listed under the primary State post. The risks calculated by OBO do not take into account (1) city or regional mitigation measures completed, under construction, or planned by host locales, or (2) risk-mitigating projects completed, under construction, or planned by OBO.

^aA post where State has built new facilities since 2000, such as a new embassy compound, new consulate compound, or new office annex. Such facilities are built to meet State’s design standards, such as adhering to modern seismic codes to afford protection from earthquakes. According to OBO, these building design aspects have not been factored into the risk scores represented in this list. Therefore, posts having a newly constructed embassy, for example, may still appear as high risk despite the code-mandated adaptation or risk mitigation measures implemented.

^bThis post is the location of the US Mission to the United Nations Agencies in Rome, Italy.

^cThis post is the location of the US Mission to the International Civil Aviation Organization in Montréal, Canada.

^dThis post is the location of the US Mission to the United Nations Educational, Scientific, and Cultural Organization in Paris, France.

^eThe American Institute in Taipei and American Institute Branch Office in Kaohsiung provide services to U.S. citizens and visas to Taiwan nationals similar to services provided by State at U.S. embassies and consulates in other countries.

Enclosure II

Department of State Risk Assessment Methodology

In its 2021 Climate Adaptation and Resilience Plan, the Department of State said it must identify emerging natural hazard risks to its real property portfolio to ensure that these risks are integrated into its planning.¹⁸ To accomplish this, State's Bureau of Overseas Buildings Operations (OBO), with support from contracted subject matter experts,¹⁹ conducted an initial assessment of the risk that eight natural hazards pose to its 294 posts²⁰ across 180 countries.²¹ OBO's definition of a natural hazard is a natural process or phenomenon that may cause loss of life, injury, or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Hazard Risk Score Formula

OBO assessed the risks to State's posts from natural hazards by combining data on eight natural hazards, with country and post-specific data on their facilities (see fig. 6).²² According to OBO officials, this initial risk assessment is iterative in nature and they intend to continue refining and updating the assessment. The assessment reflects the risk to State's real property assets (such as office buildings and staff housing) at each post, not the risk to the city where the post is located. OBO calculated the risk to posts for each natural hazard using available hazard exposure data,²³ severity data (such as the number of people at post and the value of facilities that may be exposed to damage or loss), and vulnerability data (such as age of facilities and adequacy of local health sector) using the following formula:

¹⁸U.S. Department of State, Climate Adaptation and Resilience Plan, 2021.

¹⁹According to OBO, assessing the risks that natural hazards pose to its posts requires support from a firm experienced with conducting natural hazard risk analyses. OBO hired consultants to support this effort, including analysis of available exposure data, identification of vulnerability and severity indicators, and rating and ranking the level of risk to posts posed by climate change-related, severe weather, and other natural hazards.

²⁰According to OBO, the term "post" refers only to properties in which State has real property interest and is not intended to imply operational status or purpose of a particular property. The 294 posts assessed include posts at which State has suspended operations. These posts are Kabul (Afghanistan), Basrah (Iraq), Bissau (Guinea-Bissau), Caracas (Venezuela), Chengdu (China), Damascus (Syria), Minsk (Belarus), Sanaa (Yemen), St. Petersburg (Russia), Tripoli (Libya), Vladivostok (Russia), and Yekaterinburg (Russia).

²¹The eight natural hazards that OBO considered in its 2022 risk estimation are extreme heat, extreme wind, coastal flooding, riverine flooding, water stress, earthquakes, landslides, and tsunamis. According to OBO officials, both climate and earth hazards—collectively called "natural hazards" in this report—fall within the scope of their assessment because earth and climate related events could occur in combination, compounding the effect of each other. For example, an earthquake could be closely followed by a hurricane and high levels of precipitation, further disrupting access to water, shelter, and other basic services. Furthermore, all hazards could pose risks to the safety of State personnel or to property investments.

²²OBO defined risk as the combination of exposure(s) and the severity of the consequences (i.e., injury, damage, disruption, cost) caused by the event(s) or exposure(s), and the vulnerability of the post to withstand and respond to the impact from an event.

²³The data source years for hazard exposure (e.g., earthquake source data year as compared to tsunami source data year) and geographic coverage of exposure data can differ based on available sources. OBO officials said they expect to conduct annual reviews to assess whether to update the hazard exposure data it is using as a basis for its natural hazard risk assessments.

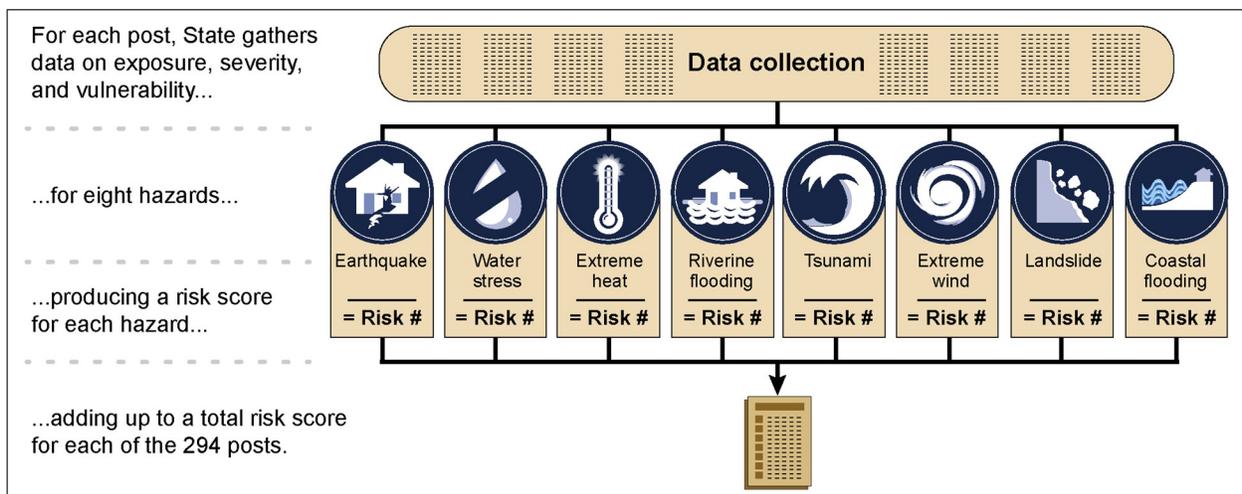
- (Preliminary risk score) x (Vulnerability Multiplier) = Hazard Risk Score

The **preliminary risk score** is a function of exposure to a hazard—which is a measure of the likelihood of the hazard occurring in a particular location—and the potential impact, or severity, of that hazard for a particular post.²⁴

The **hazard risk score** is determined by multiplying the preliminary risk determined above by a measure of the vulnerability of the post—which is a function of post specific factors (like the age of its facilities) and country-wide factors (like the adequacy of the power grid or health care sector). A post will have eight hazard risk scores, one for each hazard.

The **total risk score** for each post, as reflected in the data underlying the map and ranking in Enclosure I, is the sum of the eight individual hazard risk scores (see fig. 6). For example, consider Post A that has the following individual risk scores for the eight hazards: extreme heat (22), extreme wind (0), water stress (16), riverine flooding (13), coastal flooding (0), earthquakes (53), landslides (31), and tsunamis (0). This post’s total risk score is the sum of those individual risk scores, or 135.

Figure 6: State Methodology for Calculating its 2022 Natural Hazard Risk Scores for its Posts



Source: GAO based on Department of State documentation. | GAO-23-105452

Risk Score Elements

Exposure

OBO officials defined “exposure” as the potential of an area to be exposed to a hazard. OBO assessed all post assets, such as chancery buildings and staff housing, and assigned each an exposure score from 0 to 5 for each natural hazard type, with 0 representing the lowest likelihood

²⁴The formula used for calculation is $\sqrt{(exposure^2 + severity^2)}$ = Preliminary risk score.

of hazard occurrence and 5 representing the highest likelihood of hazard occurrence.²⁵ The entire post is assigned the greater of two exposure scores: 1) the exposure score for the post's chancery or consulate building or 2) the weighted average of exposure scores of a post's entire real property building portfolio (including off-compound annex office buildings or staff housing) located within a given city.

Severity

OBO officials defined "severity" as how damaging a disruptive natural hazard event could be on the mission, facility, and people. OBO used available State data to assign a severity indicator score of 1 to 5 to each post, with 1 representing lower severity of a hazard's damage and 5 representing higher severity. OBO developed these scores using three inputs designed to address OBO's three areas of concern: mission significance, personnel, and facilities (see table 3). When assigning mission significance, OBO gave more emphasis to larger embassy posts than smaller embassy posts and non-embassy posts (e.g. consulates). OBO estimated the number of personnel (both local and U.S. employees) and employees' family members. A higher number of personnel represents more individuals who may be injured, lost, or require evacuation. OBO also factored in the replacement value of its posts as a consideration for the value of facilities that may be damaged or destroyed.²⁶

Table 3: State Severity Indicators Used as Part of Post Natural Hazard Assessment

Severity Indicator	Area Of Concern	Severity Indicator Scores	
		1 (lowest severity)	5 (highest severity)
Mission Significance	Operations	Smaller embassy posts/non-embassy posts	Larger embassy posts
Number of Post Personnel and Family Members	People	Low number of evacuees	High number of evacuees
Replacement Value	Facilities	Smallest total replacement values	Largest total replacement values

Source: GAO based on Department of State documentation. | GAO-23-105452

²⁵OBO officials noted that their risk calculus does not take into account (1) city or regional mitigation measures completed, under construction, or planned by local host governments or (2) risk-mitigation projects completed, under construction, or planned by OBO.

²⁶OBO defines replacement value as the cost to design and construct, or acquire, an asset to replace an existing asset of the same functionality and size, and in the same location using current costs, building codes, and standards.

OBO weighted two of these three severity indicators based on global historical natural disaster impact data, such as number of fatalities and cost of damage to real property incurred from past disasters. For example, certain hazards such as extreme heat and water stress pose a threat to personnel but do not threaten facilities to the same extent. Therefore, the weighting of number of personnel and family members would be higher than that of replacement value. Other hazards pose great danger to both human life and facilities, such as tsunamis and earthquakes, so the weighting on both severity factors may be equally high.

Preliminary Risk Score

These two factors are combined into a “preliminary risk score” where high exposure and high severity result in a high preliminary risk score. OBO calculated a preliminary risk score eight times for each post, once for each natural hazard.

Vulnerability

OBO’s definition of “vulnerability” encompasses the character, condition, fragility, or attributes of people, property, infrastructure, or assets that can be adversely affected by exposure to, and the damaging effects of, natural hazards. OBO used nine factors for each post and post location to determine a location’s vulnerability (see table 4). Three factors are post- specific and use State data sources: facility condition, evacuation logistics, and facility age. The remaining six factors are countrywide indicators based on U.S. government and non- governmental data sources: travel advisory,²⁷ access to potable water and sanitation, adequacy of the health sector, adequacy of the power network, per capita gross domestic product, and supply chain logistics.

Table 4: OBO Vulnerability Indicators Used as Part of Post Natural Hazard Assessment

Vulnerability Indicator		Area of Concern	Vulnerability Indicator Scores	
1 (lowest vulnerability) 5 (highest vulnerability)				
Post-specific	Facility age	Facilities	Newest facilities	Oldest facilities
	Facility condition index ^a	Facilities	Excellent condition	Poor condition
	Evacuation logistics	People	Low number of evacuees	High number of evacuees

²⁷State issues travel advisories providing regularly updated guidance on recommended safety precautions for every country in the world.

Country-wide	Supply chain logistics ^b	Operations	High LPI score	Low LPI score ^c
	Per capita gross domestic product (GDP) ^d	Operations and people	Highest GDP	Lowest GDP
	Adequacy of power network	Operations, people, and facilities	Ample access to power network	Limited access to power network
	Access to potable water and sanitation	Operations, people, and facilities	Ample access to potable water/sanitation	Limited access to potable water/sanitation
	Travel advisory	Operations and people	Minimal travel warnings	<i>Do Not Travel</i> warnings
	Adequacy of health sector	People	Ample access to health services	Limited access to health services

Source: GAO based on Department of State documentation. | GAO-23-105452

^aState derives its facility condition index ratings from a building’s estimated cost of repair needs (cost to restore equivalent to originally intended and designed condition) and replacement value data.

^bSupply chain logistics coordinate the shipping of goods and services across the supply chain.

^cThe Logistics Performance Index (LPI) is an index developed by the World Bank and measures six dimensions of trade, including customs performance, infrastructure quality, and timeliness of shipments.

^dPer capita gross domestic product is the value of all goods and services produced within the borders of a country in a given period distributed evenly across the country’s population.

OBO assigned a score for each post on a scale of 1 to 5 for each vulnerability factor and combined them to develop a total vulnerability score for each post. Using these vulnerability scores, OBO developed a “vulnerability multiplier” for each post.²⁸ Applying the vulnerability multiplier against the preliminary risk score either increased or decreased the post’s hazard risk scores, depending on the vulnerability of the post.

²⁸OBO officials noted that OBO summed up the vulnerability scores for the available factors (up to nine) for each post and divided that by the maximum possible score. Vulnerability scores were then normalized so that vulnerability multipliers greater than 1 indicate vulnerability greater than the average and multipliers less than 1 indicate less than the average.

Data Sources

Exposure

OBO has data sets on natural hazard exposure, using resources listed below.²⁹

- Coastal flooding: The assessment used data provided by the U.S. Geological Survey and the National Geospatial Intelligence Agency, in addition to open access research data and projections provided by CLIMsystems.³⁰
- Riverine flooding: The assessment used data provided by the United Nations Office for Disaster Risk Reduction.³¹ OBO officials noted that additional types of flooding, such as pluvial flooding due to extreme rainfall, are not currently accounted for in the hazard layers, but efforts to identify and incorporate relevant data are underway.
- Extreme wind: The assessment used data provided by the National Aeronautics and Space Administration (NASA) and CLIMsystems.³²
- Extreme heat: The assessment used data provided by NASA.³³ These data were normalized based off the National Weather Service's Heat Index. The Heat Index focuses on the impact of extreme heat on human health. Effects of extreme heat on power grids and other forms of urban infrastructure that posts may rely on are not considered.
- Water Stress: The assessment used data provided by the World Resources Institute on water supply and demand by watershed.³⁴

²⁹Citations identify the data sources generally to provide insight into the types of data used in the assessment, but do not provide the exact location of the data used by OBO.

³⁰U.S. Geological Survey and the National Geospatial Intelligence Agency. *Global Multi-Resolution Terrain Elevation data*.

Vrije Universiteit Amsterdam. *Global Tide and Surge Reanalysis*.

CLIMsystems. *Sea level rise and vertical land movement data*. CLIMsystems is a software development company focused on climate change risk and adaptation assessment tools and services

³¹*Global Tsunami Model*.

³²National Aeronautics and Space Administration. *Modern Era Retrospective Analysis for Research and Applications Version 2*.

CLIMsystems.

³³National Aeronautics and Space Administration. *Modern Era Retrospective Analysis for Research and Applications Version 2*.

CLIMsystems.

³⁴World Resources Institute. *Aqueduct Water Risk Atlas*.

- Earthquakes: The assessment considered seismicity zones based on definitions adopted from the Federal Emergency Management Agency.³⁵
- Tsunami: The assessment used data provided by Geoscience Australia and the Norwegian Geotechnical Institute.³⁶
- Landslides: The assessment used data provided by the World Bank, NASA, and the National Oceanic and Atmospheric Administration.³⁷

OBO officials told GAO that they selected natural hazards datasets that were global in geographical coverage and at a consistent resolution. They further reported OBO intentionally chose readily available, global datasets as a starting point that would provide a complete global picture for exposure and to allow OBO to identify opportunities to refine or supplement these datasets where necessary.

Severity

OBO used internal data sources to measure the potential severity of a hazard at each post. For example, State's internal reports provide data on the number of personnel at post as well as their accompanying family members.³⁸ OBO also used the Centre for Research on the Epidemiology of Disasters' Emergency Event Database, which compiles historical natural disaster data on damages and fatalities per hazard event, to weight its replacement value and personnel severity indicators.³⁹ In addition, OBO used State's Global Talent Management database which includes information on the size and function of specific posts. This is used to determine mission significance of individual posts.

Vulnerability

OBO used a variety of internal and external sources to measure the vulnerability of each post. Internal information sources include estimates for number of personnel that may require evacuation, used as a proxy for evacuation logistics. State also issues public travel advisories providing regularly updated guidance on recommended safety precautions for every country around the world. OBO also maintains a Global Maintenance Management System that supports posts in planning, scheduling, and reporting maintenance for State's overseas real property at each post. This database contains information on the age and condition of facilities, as well as the replacement value for real property and assets.

³⁵Federal Emergency Management Agency. *P-154 Rapid Visual Screening of Buildings for Potential Seismic Hazards methodology*.

³⁶*Global Tsunami Model*.

³⁷The World Bank Group. *Global Earthquake-Triggered Landslide Hazard Dataset*. National Aeronautics and Space Administration. *Global Landslide Susceptibility Map*. National Oceanic and Atmosphere Administration. *Climate Prediction Center rainfall data*.

³⁸State requires posts to produce estimates of the number of private American citizens in country. These reports play a central role in State's planning for and conducting evacuations of American citizens.

³⁹Centre for Research on the Epidemiology of Disasters. *Emergency Events Database*.

In addition, OBO drew from a variety of public data sources to inform its measurement of vulnerability for post-specific and country-wide factors. Data used include:

- World Bank logistics performance index: this index compares performance of supply chain logistics of countries where the posts are located.⁴⁰
- World Bank per capita GDP: this database measures the level of wealth and resources available in the country where the post is located.⁴¹
- Global Health Security Index: this index measures, among other things, the adequacy of power networks, access to potable water and sanitation, and the capability of the health sector where the post is located.⁴²

⁴⁰The World Bank Group. *Aggregated LPI 2012-2018*.

⁴¹The World Bank Group. *GDP per capita (current US\$), World Bank Open Data*.

⁴²Nuclear Threat Initiative and Johns Hopkins Center for Healthy Security. *Global Health Security Index*.

Enclosure III: Comments from the Department of State



United States Department of State
Comptroller
Washington, DC 20520

OCT 07 2022

Thomas Melito
Managing Director
International Affairs and Trade
Government Accountability Office
441 G Street, N.W.
Washington, D.C. 20548-0001

Dear Mr. Melito:

We appreciate the opportunity to review your draft report, "OVERSEAS REAL PROPERTY: State's Initial Assessment of Natural Hazard Risks Faced by its Post" GAO Job Code 105452.

The enclosed Department of State comments are provided for incorporation with this letter as an appendix to the final report.

Sincerely,

A handwritten signature in blue ink, appearing to read "William B. Davisson".

William B. Davisson (Acting)

Enclosure:

As stated

cc: GAO – Jason Bair
OBO – William H. Moser
OIG - Norman Brown

Department of State Comments on GAO's Draft Report

**OVERSEAS REAL PROPERTY: State's Initial Assessment of Natural
Hazard Risks Faced by its Posts**
(GAO-23-105452, GAO Code 105452)

Thank you for the opportunity to review the draft report and interactive map as part of GAO's engagement on "Embassy Climate Change." In addition to the technical comments provided separately, Overseas Buildings Operations (OBO) would like to take this opportunity to express its appreciation for the GAO's attention to the progress the Department of State is making to account and prepare for the effects of climate change on the planning, design, construction, operations, and maintenance of its overseas real property assets. Given that this October 2022 draft report largely covers the natural hazard portfolio-wide risk screening recently developed by OBO's Climate Security & Resilience (CS&R) Program, and that OBO has not yet conducted derivative analyses of the assessment, the Department would appreciate if any regional observations, interpretations, and conclusions proposed by the GAO in this report be annotated as such. As the GAO engagement continues, we are looking forward to discussing the CS&R Program's anticipated growth trajectory and necessary resourcing, as determined early in 2022 through benchmarking against other federal agencies and internal staffing assessments.

(105452)

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