

Understanding Vulnerability

ADAPTING TO RISING TIDES PROGRAM

Purpose

Project participants explore the underlying causes and components of climate vulnerability, including relationships and dependencies among different assets that contribute to vulnerability.

Approach

Beginning with an (actual or hypothetical) asset, stakeholders identify and discuss characteristics that contribute to its vulnerability to selected impacts, such as sea level rise and storm events. Participants are asked to identify the relationships and dependencies with other assets and services and repeat the exercise for one or two of these connected assets and services to understand how they too may be directly and indirectly vulnerable to impacts. Time permitting, the group can discuss the consequences of the vulnerabilities that disrupt essential services or lead to cascading impacts, e.g., a power outage or road closures due to flooding that would disrupt the function of an airport having consequences on the passengers and goods movement.

Outcomes

1. Collectively, project participants – project staff, asset managers and others actively engaged in the project– increase their understanding of:
 - How relationships and dependencies among assets contribute to vulnerability and consequences
 - Commonalities among assets in terms of key characteristics, functions and relationships, such as reliance on power, water/wastewater, shoreline protection and physical access (roadways, transit, trails) to the assets.
 - How these characteristics and relationships affect the type of consequences and potentially the scale and timing of specific adaptation actions that may need to be taken.
2. Begin building relationships among working group members – many of whom may own or manage assets in the project area – who will need to coordinate or partner on the development of adaptation responses to ensure that relationships do not result in broader, regionwide vulnerabilities and consequences.

When to use this exercise...

This exercise is most helpful at the point when the project team is sharing the draft vulnerability and consequence findings of the assessment with the working group.

Logistics

At minimum this exercise requires an hour.

- Allow 5-10 minutes for the brief introduction to the exercise for the entire group, 35 minutes for the small group discussions and another 15 minutes for report-outs and discussion with the entire group.

A project team member who is very familiar with the exercise content is needed to facilitate each small group discussion. During the report out with the entire group, project staff should take notes on flipcharts.

1. Prepare

Selecting asset(s)

Based on the vulnerability assessment and consequences findings, select a few assets in the project area that clearly exemplify vulnerability characteristics and relationships. (If there is a concern that focusing on actual assets from the project area may prove controversial for some participants, this exercise can be done starting with a hypothetical asset. Refer to the Example Materials and Outcomes for a ready-to-use example.)

Example assets might include a hospital, a fire station, a school or community center, an employment center, a transit station or line, water or wastewater infrastructure, a power station, a flood control channel, etc.

To help in identifying a good starting asset, consider its physical, functional or other types of connections, and how these may be important to its continued function and viability, and vice versa. A few simplified examples:

- An employment center may rely on roadways, transit station and lines for many of its employees to commute to work and material deliveries and shipping of goods in order for employees to do their work.
- A wastewater pump station requires power to function and provides service to a particular area that may include residences, offices, hospitals and other assets.
- A school or community center may be a designated shelter during an emergency, and to serve this function, physical access to the site via certain roadways is needed during an emergency.
- Several agencies may share management responsibilities for a critical facility or property (e.g., a

levee that serves as shoreline protection for surrounding other assets and services). Making repairs or improvements requires coordinated, and potentially lengthy and expensive, planning and implementation.

- A facility such as a transit station or storage tank that relies on a physical linkage (e.g., rail line or pipeline) may be vulnerable to impacts that damage the linking assets, even when the facility itself is not exposed to impacts.

Supplies


1. Participant guide (see examples, under Example Materials and Outcomes) that includes:

- The purpose of the exercise:

Increase our understanding of relationships among assets– both within the project area and across the project area – and how these and other characteristics contribute to or reduce asset vulnerability

- Brief explanation of the activity:

We will begin by discussing the vulnerabilities of one asset to sea level rise and storm event impacts and then, using visual methods and maps, describe and communicate this asset’s relationships with other assets. Time permitting; we will repeat this exercise for one or two of the connected assets. Throughout, we will be looking for common themes or significant consequences that result from these vulnerabilities and relationships.

- Description of the starting asset and services and the types of impacts (e.g., storm flooding, higher groundwater, etc.) that are being considered
- A series of questions that will help guide the group through identifying vulnerabilities for the starting asset, and developing a conceptual map of relationships with other assets. This should include the following:
 - An example “final product”: Description of an example asset and impacts, the physical functional, information and management vulnerabilities for this asset and a conceptual map showing its relationships with other assets. Use the materials in this guide under Example Materials and Outcomes and the conceptual map below to build this example.
 - A handout identifying physical, functional, informational, and management vulnerabilities for the starting asset. These should be selected from the same questions that the project team and working group used in the vulnerability and consequences assessment. For further information about assessment questions, refer to the **How-to Guide: The ART Assessment Questions** () at the ART Portfolio: ART Supplies webpage.
 - Questions for participants to consider in creating a conceptual map of the asset’s relationships with other assets within and outside the project area.

2. Labeled map of the project area showing the starting asset and other relevant features. Plot or print a large format concept map (e.g., 36” wide) or project it onto a screen during the exercise.

3. Flip charts, markers, a camera

2. Do

1st

Hand out the participant guide. Explain the purpose and outcomes and give a brief description of the exercise. Divide into smaller groups (4-5 people) each with a project team leader/facilitator, flip chart and markers.

2nd

Each leader should review the description of the starting asset, the functions and services that it provides and the vulnerabilities with her group.

3rd

Begin the discussion by asking the group to consider and discuss the questions about physical, functional, management and information vulnerabilities of the asset. Summarize these vulnerability characteristics on the flip chart. Examples summaries are shown below under the Example Materials and Outcomes.

4th

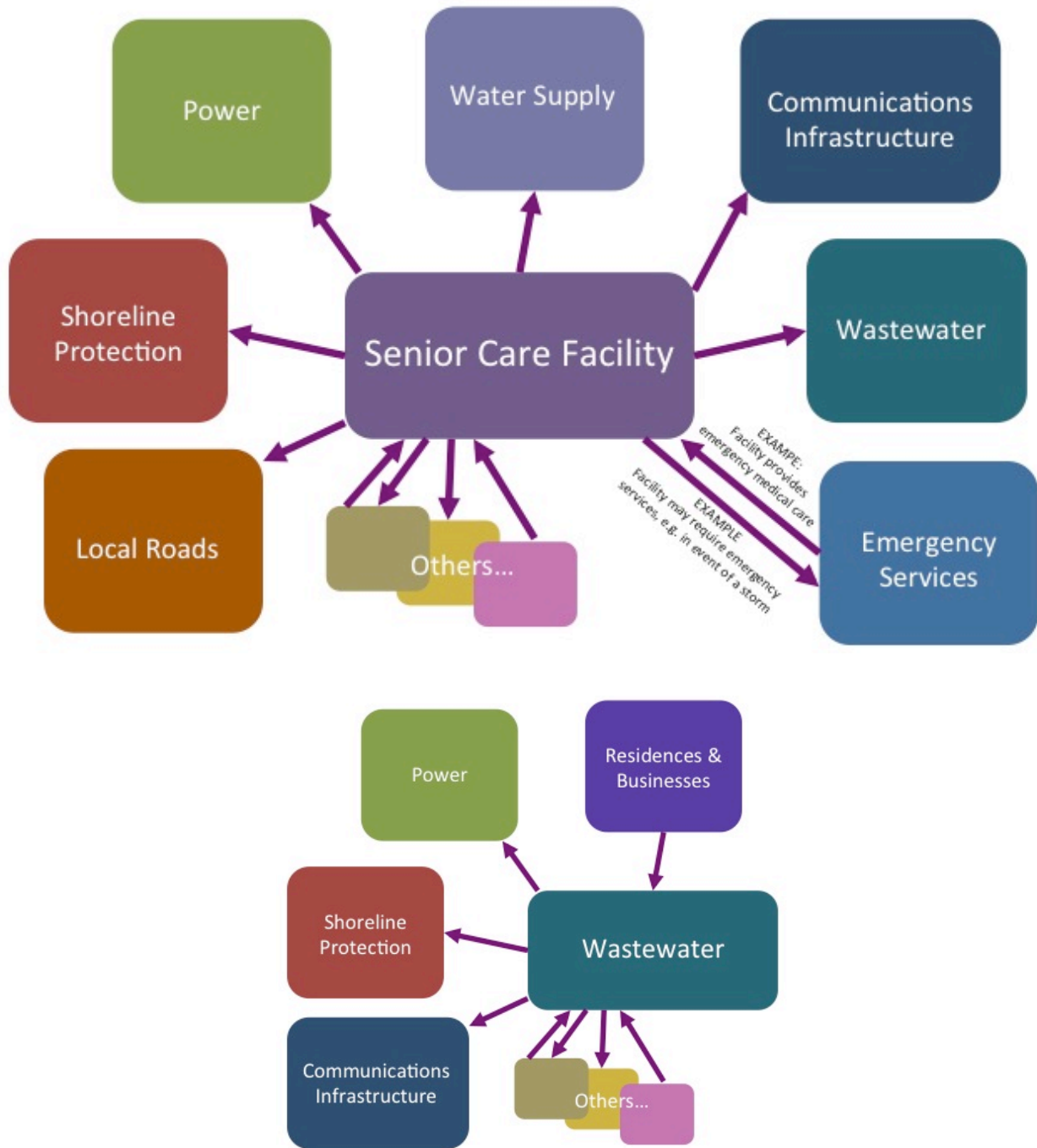
On a new flip chart page, begin a conceptual map with the starting asset name in the center. (See figure below.) Ask participants to consider services, facilities and/or infrastructure that the asset needs to function and assets that rely on the primary asset to function. Write these in the space around the starting asset and draw arrows connecting related assets, using the arrows to demonstrate reliance. Along the arrow, describe the relationship. Next ask participants to consider the reverse situation – other assets that depend upon the starting asset – and describe (along with arrows pointing outward) these relationships. Lastly, ask the participants to consider how adjacent land uses, such as a landfill, hazardous material storage facility, contaminated lands, a zoo, etc, might affect the primary asset (or, vice versa) in the event that the impact (e.g., storm flooding) occurs. Use a different notation (e.g., wiggly lines with arrows) to indicate these connections.

5th

Select one of the other connected assets from the conceptual map and do a quick lightening round version of the previous two steps for this other asset. Ask the group what they would need to know about this other asset to understand its vulnerabilities and relationships.

CONCEPTUAL MAP

An example of what conceptual maps might look like for a senior care facility and one of the connected assets, a wastewater treatment facility. For the exercise, participants should note the relationships for each asset connection (as shown for the Emergency Services arrows in this figure).



6th

Reconvene the groups and post, side-by-side the different conceptual map drawings. The wrap up discussion can be a free form report out of the small group discussions and participants' observations, or for a more structured format, ask groups to recap different, specific, aspects of the exercise:

Group 1:

Summarize the types of vulnerabilities that were identified for the starting asset. Ask the other groups if they have any more to add.

Group 2:

Review the relationships that they identified for this starting asset. Again, ask the other groups if they found additional relationships that were not already mentioned.

Groups 3,4,5:

Summarize the types of vulnerabilities and new relationships identified for a different asset.

Last group:

Identify relationships that were relevant for more than one asset, such as reliance on certain utility services or shoreline protection.

Everyone:

Consider vulnerabilities (or aspects of vulnerability) that can be addressed independently by an individual asset manager versus more complex vulnerabilities, such as those affected by asset relationships, which may require coordination and/or a longer timeframe to address.

3. Follow-up

Relatively little follow-up is needed for this exercise, however it is important to take advantage of the improved awareness and understanding of the complexities of vulnerabilities that participants likely gained. Be ready to share – at the same meeting as the exercise or shortly afterward – the asset profile sheets (with the completed vulnerability and consequence statements) with the relevant asset owners, managers and stakeholders for their review and input.

Additionally, the project team should summarize the exercise and key outcomes, and share the summary with stakeholders in the meeting notes. Any relevant feedback and new information about assets' vulnerability that came out of the discussions should also be incorporated into the assessment findings.

Example Materials & Outcomes

Participant Guide

The following is an example hypothetical asset and exercise questions that ART used for the pilot project. As this is a made up asset, participants can choose answers as they wish to create a vulnerability and consequence profile and a conceptual map of asset relationships. Even though they are not using a real asset from the project area, participants still gain a better understanding of some of the considerations and complexities of vulnerability caused by connections among assets.

Example: “Oak Grove Senior Residences”

Oak Grove Senior Residences is a “campus” type facility that offers three levels of service to seniors- independent living, assisted living, and skilled nursing (respite care). Oak Grove is home to over 85 residents and employs 40 nurses and other caretakers. It is located near the Bay shoreline, adjacent to a single-family residential neighborhood, a mixed-use downtown shopping district, and a regional shoreline park.

With 12 inches of sea level rise (~ mid-century) Oak Grove will be at risk of flooding during large storm events. The facility is currently protected from extreme Bay tides by structural and natural shoreline features. However, stormwater facilities in the area are undersized and cause street flooding during extreme tides coupled with heavy rains. The facility may also be vulnerable during a seismic event due to shoreline failure.

Physical Qualities Vulnerabilities:

- The facility has __ floors and is served by stairs/elevators/both
- The facility was built in _____ and therefore is compliant/not compliant with modern building codes
- Electrical/mechanical equipment is/is not located in basements or below ground level
- The facility does/does not have sand bags or other flood protection devices on site
- Other:

Functional Qualities Vulnerabilities:

- There are/are not residents with special medical needs
- There are/are not residents that do not own or operate a personal vehicle
- There are/are not memory challenged or Alzheimer’s residents
- There is/is not access to back up power (generators) at the facility
- The facility does/does not have food and water supplies for at least __ days
- Other:

Governance Vulnerabilities:

- The facility emergency response plan is/is not up to date. Staff are/are not trained on the plan
- There are/are not open channels of communication with community emergency responders
- Other:

Information Vulnerabilities:

- There are/are not clear lines of authority to determine evacuation procedures
- Emergency responders have/do not have up-to-date information on the number and needs of residents
- Other:

Identify external services, facilities and infrastructure Oak Grove relies on to function:

- Energy/electricity
- Water
- Wastewater
- Communications
- Ground Transportation
- Other:

Are there adjacent land uses that might affect the facility during a flood?

- Landfill
- Hazardous material storage facility
- Zoo
- Other:

Example Outcomes

For the example of the senior residence facility (above), a summary of vulnerability characteristics and connections could look like the following:

Physical:

Building is made from materials that are not waterproof. It was built in the early 20th century and has not been seismically retrofitted. The entrance and first floor, which is inhabited by residents, are at grade. The mechanical and electrical equipment for the building (e.g., elevator, circuit breaker, etc.) are in the basement.

Functional:

The residents have special medical needs, including dementia and medication. There is a generator located in the basement with one day's worth of fuel. The home has several days' worth of food in its kitchen at any given time, but relies on weekly deliveries of groceries and trained kitchen staff to prepare meals. Utility services are provided by EBMUD and Alameda Power and Light.

Governance:

The facility's emergency response plan is out of date. The facility has no clear channel of communication with the local fire department. Facility staff are not involved in community emergency response planning efforts.

Information:

Emergency responders do not have up-to-date information on the number and needs of residents.

Connections:

The facility relies on utility services – water, wastewater, power – which originate outside of the project area and may have nodes (substation, pump station) within the project area. It relies on roads for access – for staff to get to work, family members to visit, food delivery, and residents to get to the hospital if necessary.