RESEARCH/PD ANNUAL REPORT - PROGRESS REPORT

2015 annual report - progress
Scott Miles
Planning for Coastal Community Resilience to Tsunamis Using Transportation and Disaster Recovery Modeling
R/RCE-2
Submitted On: 04/22/2016 02:53:08 PM

METRICS & MEASURES

Metric/Measure	Value	Note
Acres of coastal habitat	0	Not a focus of the funded proposal.
Fishermen and seafood industry personnel	0	Not a focus of the funded proposal.
Communities - economic and environmental development	0	Not a focus of the funded proposal.
Stakeholders - sustainable approaches	0	Not a focus of the funded proposal.
Informal education programs	0	Not a focus of the funded proposal.
Stakeholders who receive information	65	Attendees at presentations
Volunteer hours	0	Not a focus of the funded proposal.
P-12 students reached	0	Not a focus of the funded proposal.
P-12 educators	0	Not a focus of the funded proposal.

REQUESTED INFORMATION

Publications

Simulating Disaster Recovery as Discrete Event Processes using python
Publication Type: Peer-reviewed: Journals (incl. articles), Books, Proceedings, and Other Documents
Publication Year: 2015
Publication Authors:
Publisher Info: Proceedings of the IEEE Global Humanitarian Technology Conference
Notes:
Related URLs:
Keywords: disaster, recovery, housing, simulation, modeling
Publication URLs: http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7343980&filter%3DAND%28p_IS_Number%3A7343935%29%26pageNumber%3D2
Abstract: Community disaster resilience is commonly conceptualized as the capacity to reduce post-event loss and facilitate effective recovery. Technologies, such as data systems, computer models, and visualization tools, are more common and well developed for understanding immediat (and static) loss than for understanding dynamic processes of recovery. Most available technology for understanding post-disaster dynamics is specific to short-term emergency or crisis processes. As a result, development of simulation models of recovery is necessary to enable technology-supported decision making for realizing community disaster resilience. We present a proof of concept design for a home reconstruction discrete-event simulation (DES) to evaluate its potential for simulating disaster recovery in general. The design is implemented as a prototype using the SimPy discrete-event simulation Python library. Preliminary outputs from the prototype simulation

suggest that DES is appropriate and promising for modeling home reconstruction. The ability to alter the quantities of shared resource stocks, event durations, and access qualifications can likely facilitate modeling of other types of recovery processes, as well as a variety of post-disaster scenarios. As such, DES appears to be a novel technological approach that can be developed to support pre-and post-disaster decision making for improved community disaster resilience.
Citation: D. Huling and S. B. Miles, "Simulating disaster recovery as discrete event processes using python," Global Humanitarian Technology Conference (GHTC), 2015 IEEE, Seattle, WA, 2015, pp. 248-253. doi: 10.1109/GHTC.2015.7343980
Citation for Coverpage:
SG can post PDF online?: Yes
Uploaded File: 07343980.pdf

Disaster Management: Enhancing Socio-technical System Support
Publication Type: Presentations (non-peer-reviewed)
Publication Year: 2015
Publication Authors:
Publisher Info: IEEE Global Humanitarian Technology Conference
Notes:
Related URLs:
Keywords: disaster, recovery, simulation, modeling
Publication URLs:
Abstract:
Citation: Huling, D. (2015) “Disaster Management: Enhancing Socio-technical System Support", IEEE Global Humanitarian Technology Conference, Seattle, WA
Citation for Coverpage:
SG can post PDF online?: No
Uploaded File:

Conceptualizing and Simulating Disaster Recovery Processes
Publication Type: Presentations (non-peer-reviewed)
Publication Year: 2015
Publication Authors:
Publisher Info: Natural Hazards Workshop
Notes:
Related URLs:
Keywords: disaster, recovery, simulation, modeling
Publication URLs:
Abstract:
Citation: Huling, D. (2015) “Conceptualizing and Simulating Disaster Recovery Processes", Natural Hazards Workshop, Broomfield, CO.
Citation for Coverpage:
SG can post PDF online?: No
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Students Supported

Derek Huling (Continuing Student)
hulingd@students.wwu.edu
Western Washington University, Geography

Field of Study: Geography
Advisor: Rebekah Paci-Green
Degree Type: MS
Degree Year: 2016

Student Project Title: TBD

Involvement With Sea Grant This Period (capstone, fellow, intern, etc.): Research staff on the project through University of Washington.

Post-Graduation Plans (employer, grad school, etc.): Disaster planning, spatial analysis, and geovisualization in the private sector.

Was this thesis/dissertation supported by Sea Grant?: Yes

Thesis / Dissertation: TBD

New or Continuing?: continuing

Degree awarded this reporting period?: No

Financially supported?: Yes

Maura Rowell (New Student)
mkrowell@uw.edu
University of Washington, Civil and Environmental Engineering

Field of Study: Civil and Environmental Engineering
Advisor: Anne Goodchild
Degree Type: PhD
Degree Year: 2016

Student Project Title: TBD

Involvement With Sea Grant This Period (capstone, fellow, intern, etc.): Research assistant

Post-Graduation Plans (employer, grad school, etc.): Research and academics.

Was this thesis/dissertation supported by Sea Grant?: No

Thesis / Dissertation: TBD

New or Continuing?: New

Degree awarded this reporting period?: No

Financially supported?: Yes

Narratives

Pacific County recovery simulation progress narrative
Uploaded File: Pacific_County_Tsunami_Washington_Sea_Grant_Report_2016_narrative.pdf

Partners This Period

No **Partners This Period** information reported

STANDARD QUESTIONS

Impacts and Accomplishments

(1)

Type	accomplishment
	Washington Sea Grant research models long-term

Title	post-disaster housing and transportation recovery in a vulnerable coastal county
Relevance	Long-term disaster recovery is a critical but neglected and understudied core component of community resilience, particularly in Washington's Pacific County, which is very exposed to earthquake and tsunami hazards.
Response	Washington Sea Grant-supported researchers developed long-term simulation models of household migration and transportation and housing recovery following a disaster. They used U.S. census data, previously unreleased FEMA loss projections, and Pacific County parcel, school and business spatial data to characterize baseline travel behavior and potential earthquake and tsunami impacts on housing stock and passenger and freight transportation. Over the course of two years, they convened workshops with FEMA representatives, academic researchers and local officials, as well as stakeholders to discuss long-term recovery concerns and planning goals.
Results	The workshops identified housing and transportation as primary post-recovery concerns in Pacific County. Researchers vetted the housing-recovery simulation in prototype and partly implemented it, and have nearly completed implementation of the transportation-recovery simulation. The extensive data, compiled in GIS and spreadsheets, will provide a foundation for exploring different disaster impact scenarios and their effects on recovery outcomes. Published and presented at the 2015 Natural Hazards Workshop and IEEE Global Humanitarian Technology Conference, these findings informed a growing cadre of researchers interested in long-term recovery simulation.
Recap	Washington Sea Grant-sponsored researchers developed and implemented simulation models for post-disaster housing and transportation recovery in a vulnerable coastal county, catalyzing federal, academic and local awareness of earthquake and tsunami dangers.
Comments	
Primary Focus Area	Healthy Coastal Ecosystems
Secondary Focus Areas	
Goals	Communities prepare, respond and adapt to coastal hazards and climate change.
Partners	Coast Seafoods, Co. Federal Emergency Management Agency, Region X (US DHS, FEMA) Pacific County Economic Development Council Pacific County, Emergency Management Agency

	Port of Ilwaco, WA
	* Type accomplishment * Title Pacific County awareness of long-term recovery * Relevance Long-term recovery is a critical, under-studied, and rarely planned for aspect of community resilience. * Response Workshop of local government and stakeholders were held in Pacific County and are planned for the future. * Results Pacific County officials and stakeholders expressed concern and interests regarding issues of long-term recovery, particularly related to transportation and housing. * Recap The workshops conducted to date catalyzed awareness building for long-term recovery issues in Pacific County. Comments Primary Focus Area Healthy Coastal Ecosystems Secondary Focus Areas Goals Coastal communities and economies are vibrant and resilient.,Coastal communities engage in comprehensive planning and sustainable development. Partners Pacific County Emergency Management Agency, Pacific County Economic Development Council, Port of Ilwaco, Coast Seafoods Company ---------- * Type accomplishment * Title Focused FEMA and UW on Pacific County long-term recovery * Relevance Long-term disaster recovery, which is a core component of community resilience, is a minor focus FEMA pre-event planning efforts and research efforts in the State of Washington. Very little attention has been given to these issues in Pacific County specifically. * Response A workshop was held with multiple representatives from FEMA Region X, as well as researchers from University of Washington to discuss long-term recovery concerns and planning efforts in Washington State and, specifically, Pacific County. * Results The workshop provided insight to the project regarding priority areas to address as part of the project, including factors influencing recovery, recovery impacts to emphasize, and disaster scenarios to compare. * Recap A workshop was held with FEMA Region X officials and UW researchers to discuss and identify issues of long-term disaster recovery in the state and Pacific County. Comments Primary Focus Area Healthy Coastal Ecosystems Secondary Focus Areas Resilient Communities and Economies Goals Coastal communities and economies are vibrant and resilient. Partners FEMA Region X, University of Washington Institute for Hazards Mitigation Planning and Research ---------- * Type accomplishment * Title Developed input data for long-term recovery simulation modeling * Relevance In order to understand the post-disaster recovery dynamics of Pacific County, a large range of data had to be identified, estimated, and compiled. This data provides the foundation for exploring different disaster impact scenarios and the effects on recovery outcomes for the county. * Response The two data sets most critical to the project are United

PI Draft	States census data (socio-economic demographics) and disaster loss data generated from FEMA (HAZUS-MH). FEMA Region X provided tsunami loss estimates for Pacific County that have not been released to the public, in addition to providing training on how to work with this data. These data sets, in addition to Pacific County parcel, school, and business spatial data), were used to estimate earthquake and tsunami impacts to the transportation and housing stock in Pacific County, as well as characterize household and business travel behavior (as the baseline to understand how this changes during disaster recovery). * Results The newly compiled data sets (estimates) are in the form of spreadsheet files and GIS data files. * Recap Input data was identified, estimated, and compiled for running long-term recovery simulation models for Pacific County. Comments Primary Focus Area Healthy Coastal Ecosystems Secondary Focus Areas Resilient Communities and Economies Goals Coastal communities and economies are vibrant and resilient. Partners FEMA Region X ---------- * Type accomplishment * Title Designed and partially implemented a simulation model of housing recovery * Relevance Housing recovery after a major earthquake was identified in workshop with Pacific County emergency managers and stakeholders as a primary concern for long-term recovery planning. * Response A housing recovery and household migration simulation for understanding post-disaster recovery dynamics in Pacific County WA has been fully designed. * Results Roughly, 40-50% of simulation design has been coded/implemented to date. Roughly 85% of the design has been prototyped (shown to work). * Recap A simulation model of post-disaster housing recovery has been designed to address identified concerns of Pacific County emergency managers and stakeholders. Comments Primary Focus Area Healthy Coastal Ecosystems Secondary Focus Areas Goals Coastal communities and economies are vibrant and resilient. Partners ---------- * Type accomplishment * Title Disseminated project innovations on post-disaster housing recovery simulation * Relevance Post-disaster housing recovery simulation and long-term recovery simulation in general is an under-researched area of disaster studies. * Response Because there is growing interest in the use of disaster recovery simulation models, in addition to a small but growing number of interested researchers, it is critical to disseminate research progress on this topic. * Results Initial results of this project were presented at the IEEE Global Humanitarian Technology Conference and the Natural Hazards Workshop in 2015. A paper was also published in association with the IEEE conference. * Recap Progress on the development of the housing recovery simulation for

	this project was published and presented at two major conference in the disaster research field. Comments Primary Focus Area Healthy Coastal Ecosystems Secondary Focus Areas Goals Coastal communities and economies are vibrant and resilient. Partners ---------- * Type accomplishment * Title Designed and partially implemented a simulation model of post-disaster transportation changes * Relevance Transportation impacts and restoration after a major earthquake was identified in workshop with Pacific County emergency managers and stakeholders as a primary concern for long-term recovery planning. * Response A transportation simulation for understanding post-disaster recovery dynamics in Pacific County WA has been fully designed. * Results To date, a large portion of the transportation recovery simulation design has been coded/implemented, including passenger travel (school, work, shopping) and freight transportation related to Pacific County industries (e.g., seafood processing). * Recap A simulation model of post-disaster passenger travel and freight transportation dynamics in Pacific County has been designed and partially implemented. Comments Primary Focus Area Healthy Coastal Ecosystems Secondary Focus Areas Goals Coastal communities and economies are vibrant and resilient.,Communities prepare, respond and adapt to coastal hazards and climate change. Partners

Tools, Technologies, Information Services / Sea Grant Products

(1)

Description	Simulation model of post-disaster travel and freight transportation dynamics in Pacific County, WA.
Developed (in the reporting period)?	Yes
Used (in the reporting period)?	No
Used for EBM?	No
ELWD product?	No
Number of managers	0
Description/Names of managers	Eventually the tool will be provided to Pacific County emergency managers, transportation managers, tax assessors, and land use planners

(2)

Description	Simulation model of post-disaster housing recovery and household migration in Pacific County, WA.
Developed (in the reporting	Yes

period)?	Yes
Used (in the reporting period)?	No
Used for EBM?	No
ELWD product?	No
Number of managers	0
Description/Names of managers	Eventually the tool will be provided to Pacific County emergency managers, transportation managers, tax assessors, and land use planners
Reported in previous year?	No

Economic Impacts

No **Economic Impacts** information reported

Community Hazard Resilience

No **Community Hazard Resilience** information reported

Meetings, Workshops, Presentations

(1)

Type of Event	Public or professional presentation
Description	October 2015, IEEE Global Humanitarian Technology Conference, Seattle, WA. “Disaster Management: Enhancing Socio-technical System Support"
Event Date	10-09-2015
Number of Attendees	25

(2)

Type of Event	Public or professional presentation
Description	July 2015, Natural Hazards Workshop, Broomfield, CO. “Conceptualizing and Simulating Disaster Recovery Processes"
Event Date	07-06-2015
Number of Attendees	40

(3)

Type of Event	Sea Grant-sponsored/organized event
	Workshop with FEMA staff - to 1) describe the aims of our project, 2) discuss as a group the progress of

Description	risk mapping and loss estimation done by FEMA in Pacific County, 3) discuss the reaction of Pacific County stakeholders to FEMA's dissemination of that information, 4) discuss the value of conducting recovery simulation for the area, 5) evaluating the benefit of focusing on transportation and housing, and 6) the key scenarios and variables to modify and investigate using the simulation models.
Event Date	07-26-2015
Number of Attendees	5

Leveraged Funds

(1)

Purpose	Planning for Coastal Community Resilience to Tsunamis Using Transportation and Disaster Recovery Modeling - further simulation model development
Source	National Science Foundation
Amount	65972
Start Date	09-01-2015
End Date	01-31-2016

Narrative

Project Objectives, Changes, and Challenges

The objectives of the project have been modified in consultation with Washington SeaGrant (WSG). The most significant modification was the elimination of the proposed socio-behavioral experiment, related to Objectives 2 and 5 of the original proposal. This was to consist of the design and execution of a workshop-based data collection strategy to understand how stakeholders approached recovery planning without (workshop 1) and with (workshop 2) the information and tools generated from this project. It was realized that there was perception from some stakeholders that the project would conduct recovery planning, which is not the case. It was also decided that it was inappropriate to subject Pacific County stakeholders to the experimental design, wanting to avoid any harm to relationships through unmet expectations. In place of the socio-behavioral experiment, we are employing a more informal needs-based approach to the project. Rather than workshops conducted to implement a socio-behavioral experiment, informal needs assessment and product evaluation meetings have been and will be conducted with stakeholders as necessary. Results of these meetings will not be quantified (e.g., with questionnaires) and analyzed in any form way, as originally proposed.

The second most significant change or potential change relates to conducting loss estimation for Pacific County related to a Cascadia Subduction Zone earthquake and tsunami—something originally proposed. As a result of the above phone call and meeting, it was decided that it is better to ensure data consistency with other analytical initiatives focused on Pacific County—in particular, loss estimation analysis by FEMA and Washington State Emergency Management Division. As a result, the project team has postponed consideration of conducting loss estimation specific in favor of waiting to understand how input data needs for project models will fit with existing (or pending) data (being) developed by other stakeholders. At this point, it's not expected that the project team will do loss estimation. This, together with eliminating the socio-behavioral experiment, allows for more detailed model needs assessment and development. As result, less model implementation activity has occurred to date than originally expected. This is to understand how the modeling scope can be expanded and customized, as well as made more transferable to future similar applications.

During the project reporting period, significant delays were encountered as a result of the one of the principal investigators changing employers and having to transfer the grant funds.

Data Development

Data for individual household units have been simulated by combining address data, land use data, and block-level 2013 American Community Survey data (U.S. Census). Addresses were taken from Pacific County's GIS database. Residential addresses were extracted. This list was randomly sampled with replacement to create a list of occupied housing units. These units were randomly assigned demographic attribute values based on the average value within each census block. The simulation models will be run for many realizations to minimize the effects of randomly assigning household characteristics to specific addresses and other probabilistic representation of input parameters.

Each household unit is currently characterized by eleven assigned attributed: (1) household size, (2) number of vehicles, (3) number of household members under 5, (4) number of household members between 5 and 10, (5) number of household members between 11 and 17, (6) number of working adults, (7) address, (8) assigned elementary school, (9) assigned middle/high school, (10) assigned central business district (CBD), and (11) assigned farm district. Children between 5 and 10 attend elementary school and children between 11 and 17 attend middle/high school. The schools, CBD, and farm center are assigned according to zip code. All household characteristics are coded as a percentage of either the total population or the total occupied housing units so the numbers will change if either parameter changes. CBD locations are set as city hall or the post office.

With the developed housing unit data, impacts from a future scenario earthquake and tsunami were estimated by randomly assigning damage and loss values to each household unit based on predicted values using FEMA's HAZUS-MH loss estimation model. The HAZUS-MH estimations are provided at the census block level and so statistical simulation is required to derive estimates for each modeled housing unit. Based on HAZUS-MH training provided by FEMA Region X, USGS shake maps, tsunami inundation predictions, and HAZUS loss estimates have been incorporated into the housing recovery model input data sets to simulate recovery dynamics in Pacific County after a future Cascadia Subduction Zone scenario.

Transportation Simulation

The transportation simulation represents an average day during a given season (school year and summer). It includes passenger vehicle and freight vehicle trips. Passenger vehicle trips are limited to school, work, and shopping trips. To date, we have generated household units and personal trips. All persons going to the same location (multiple school children attending the same school) from one household unit have been assumed to travel together in both directions. All working adults and school-aged children have been assumed to work/attend school Monday through Friday and travel during the morning and afternoon peak periods. The trips are overlaid to find the most utilized road segments but congestion is not accounted for. Shopping trips have been modeled to take place throughout the day.

Freight vehicle trips are limited to select industries and major freight facilities (e.g., ports, warehouses). Trips are calculated using shortest distance and aggregated to describe the county's overall transportation demand. The model has been scoped to focus on oyster farming, cranberry farming, and logging. At this point, the major facilities have been located in order to simulate the freight transportation generated by these industries. Trips have been simulated between these major facilities at varying levels for a baseline scenario. Multiple post-disaster transportation scenarios have been developed: (1) bridge reconstruction scheduling, (2) U.S. Route 101 and 105 reconstruction scheduling, (3) aquaculture supply chain disruption, cranberry supply chain disruption, and lumber supply chain disruption, as well as scenarios related to household, school, and CBD dislocation or relocation.

There are 62 bridges in Pacific County. Taking the subset of scenario-based damaged bridged, a number of permutations of bridge reconstruction schedules will be analyzed. The pre-disaster transportation flow is has been used to identify the most critical bridges and prioritize those in the subset of permutations chosen. To hasten data and model development, bridges will initially be assumed to have equal repair/replacement cost and timelines. The simulation will be run after each bridge is reconstructed; the change in travel time and routes will be tracked. We will present the schedules that have the lowest maximum travel time (between two bridge reconstructions) and the lowest overall travel time (between first and last bridge reconstruction). The U.S. 101 and 105 disruption scenarios will identify which sections are most critical.

The transportation modeling has focused on the damage scenario that will be used is the Cascadia Scenario 1A (FEMA Region X). The areas affected are assumed to be the areas with moderate to high ground shaking susceptibility. The passenger intact and damaged scenario models are complete as well as the forestry model. The models for the cranberry and oyster industries are in progress. The output that is compared between the intact and damaged scenarios are: (1) change in travel distance; (2) percent of trips that got longer and trips that stayed the same distance; (3) the percentage of trips that are no longer possible on the network; and (4) the distributions of travel distance. The recovery scenarios will potentially include relocation at different locations and different percent occupied households. Another recovery scenario to be modeled is to assume the network/households are reconstructed as in the intact scenario but a different demographic remains (e.g., less schoolchildren, fewer employed adults, fewer occupied households).

Long-Term Recovery Simulation

A simulation model of long-term recovery, with an emphasis on post-disaster housing dynamics, has been designed and partially implemented that can inform the transportation simulation model to investigate some post-disaster scenarios, as well as be informed by the transportation simulation model to investigate other scenarios. The simulation model has been coded using the open source SimPy library for Python. A different simulation approach than originally proposedwas adopted and fully prototyped. The decision to do this was based on the types of issues, factors, and concerns raised by Pacific County stakeholders, as well as FEMA Region X officials and University of Washington researchers. The decision was also made in order to maximize generalizability and flexibility in tailoring the model as part of future collaborative modeling workshops in Pacific County and other coastal communities

We have fully designed, prototyped, and partially implemented a spatially explicit process-based discrete event simulation (PBDES) modeling framework that is intended to support the specification of tailored post-disaster recovery scenarios that emphasize the role of post-disaster housing dynamics and transportation impacts. The elements of PBDES include the simulation environment (scope and exogenous inputs), modeled entities (e.g., households and FEMA), entity attributes (e.g., owner vs. renter), entity states (e.g., house occupied vs. house unoccupied), processes (e.g. house reconstruction or household relocation), events (e.g., insurance claim settlement), event durations, and resources (e.g., construction workers or savings account). Events related to one or more processes can trigger other events, changes to entity states, and the interruption of processes. Process interactions occur via triggers or state-changes tied to the same events and competition for resources. Three general types of resources can be conceived: 1) resources that can only be accessed by an individual (e.g., house or bank accounts), 2) shared resources that can be used by a limited number of entities or processes at a time (e.g., claims adjusters), and 3) resources that are exchanged as a homogeneous, undifferentiated stock (e.g., money or machine parts).

Some simulation parameters include the possible qualitative and quantitative states that entities can take on. For example, as currently implemented a house might go through the following states during a recovery process: damaged/unoccupiable, damaged/inspected, damaged/ occupied, and undamaged/occupied. Other parameters quantify event durations (time to construct a single family wood frame house) and resource magnitudes (number of qualified inspectors). Durations and magnitudes are represented by probability distributions to characterize associated uncertainties. (This necessitates running and averaging many realizations of the simulation.) Event duration and resource magnitude parameters have been assumed at this point as part of scenario development (e.g., to explore the availability of fewer workers or jobs). The intention is to also base these parameter values on time series data from other disasters already compiled by team members for a separate project, as well as data provided by local government departments (e.g., planning and permitting)

Process interactions between scoped entities (e.g., households, infrastructure providers, employers, schools) and recovery stakeholders (e.g, lenders, FEMA, construction companies) have been operationalized as temporally discrete events that occur relative to spatial units greater or equal to parcels within Pacific County. For example, household relocation is represented as movement between Pacific County census blocks or movement out of Pacific County, but can also be represented as specific changes in parcel addresses.

The focus of the simulation model is centered around household recovery in order to understand the broader systems of interactions between the actors involved in recovery and those providing services and resources (FEMA, banks, etc) to those actors. A large effort was made in the past year to restructure the simulation code to be more accessible to experiment with, as well as increasing clarity for demonstrating and applying in workshop setting for interested stakeholders and community members. The simulation design moved from an object-class oriented structure to a more classically procedural structure, making alterations and linearity of code easier to read and understand. Abstraction has been a goal with this refactoring strategy, writing modular functions that can be built according to the end user's need; in many cases the model specification can be done on the fly (i.e., during a workshop).

A benefit of the code restructuring is the ability to “sandbox.” This allows practitioners to use their local knowledge and recovery plans to inform simulation parameters to understand long-term recovery outcomes. Examples of this include altering percentages of insured individuals, number of inspectors, engineers, or construction workers. We have developed using a browser-based integrated programming environment that allows facilitates easy to read code, interactive visualization, and collaboration flexibility among researchers and technically-literature stakeholders. Coordination with Pacific County emergency management personnel to workshop the model to help inform their recovery planning is ongoing. A workshop will be conducted in late spring / early summer to finalize the selection of recovery scenarios and input parameters.