



Claims Analysis Report: Puente Hills Earthquake

Prepared for the California Commercial Portfolio for Company A Insurance Company

January 2019

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1. Executive Summary

This Claims Analysis Report was executed for COMPANY A using claims data provided for the September 7, 2018 Puente Hills Earthquake. Within this report, RMS has analyzed the COMPANY “A” exposure data and corresponding claims data.

Initial estimates by COMPANY A on the California commercial portfolio showed losses were underestimated in the Puente Hills Earthquake (by 22%). After analysis by RMS and the application of demand surge and changes to actual coverage values, the modeled losses were underestimated by just 2%. The table below summarizes actual and modeled gross losses after accounting for demand surge.

Actual Gross Loss	Modeled Adjusted Gross Loss	Model/Actual
\$16,084,851	\$15,800,997	98%

Only 21 accounts make up the total incurred loss for this event and six of the accounts produce 70% of the total loss. RMS has found when analyzing the commercial book that only a handful of accounts drive the total gross incurred loss for the event. This is a symptom of the sensitivity of this type of book to catastrophe losses.

RMS will be reviewing an extensive amount of loss data in order to understand reasons why modeled losses do not match actual losses. Key findings that directly relate to the COMPANY A California portfolio include:

- Coding issues – Based on reviews of claims data some under prediction of losses can be attributed to exposure coding issues including under-reporting of values, mis-coding of financial policies, and mis-classification of building characteristics.

The above issue has an impact on the estimated losses for the portfolio. Individually, this issue would have moderate impacts on modeled portfolio losses. However, in combination with other issues the impacts could be significant. The effects of these issues are more pronounced for excess policies as compared to primary policies since losses to high layers can be extremely sensitive to changes in mean losses and/or modeling of both the uncertainty and correlation.

Contents

1. Executive Summary	iii
2. Analysis Objectives and Description.....	1
Summary of Portfolio Provided	1
Exposure Data Description	4
Claims Data Description	6
Geographic Extent of Analysis.....	6
Key Data Preparation Assumptions	7
3. Model to Incurred Loss Ratios	11
4. Account Level Analysis	12
Appendix B: Analysis Assumptions	15
Exposure Data Assumptions	15
Vintage of Exposure	15
Exposure Excluded from the analysis	15
Data Quality: Adjust for Insurance to Value	16
Data Quality: General Coding Issues.....	16
Claims Data Assumptions.....	16
Treatment of Open Claims.....	16
Ignored Claims Data.....	17
Linking Claim Locations to Exposure Assumptions	17
Adjusting Losses to Replacement Cost Value (RCV).....	19

2. Analysis Objectives and Description

Following the Puente Hills earthquake, RMS embarked on an effort to collect claims data from its clients to review, and where appropriate, update our California earthquake model. The purpose of this analysis is to review the performance of RMS' California earthquake model for the COMPANY A California portfolio and claims. Claims, exposure data, and model results have been used to identify and quantify differences between model and incurred losses.

The remainder of this report is divided into four sections. This section describes any adjustments or assumptions that have been made to the exposure and claims information to ensure accurate conclusions can be made. Adjustments to exposure information relate to timeliness of the data, accuracy of replacement cost values, and accuracy of how the data is coded for use in RiskLink. Adjustments to the claims information relates to adjusting from actual cash value to replacement cost value and removing any claims that are not related to the earthquake event. In Section 3, issues that affect a direct comparison of incurred losses with modeled losses are quantified. Incurred losses are compared to modeled losses by event and differences that exist are explored. In section 4, specific high loss account losses are examined to gain further insight into claims and modeled loss issues. The final section of this report contains a summary of conclusions and next steps drawn from this analysis.

Summary of Portfolio Provided

For the California Commercial Property book, COMPANY A writes primary and excess policies for a mixture of commercial and industrial business classes. The California portfolio has a total sum insured of \$1,949,125,905.37 with \$614,315,900 sums insured for terrorism coverage.

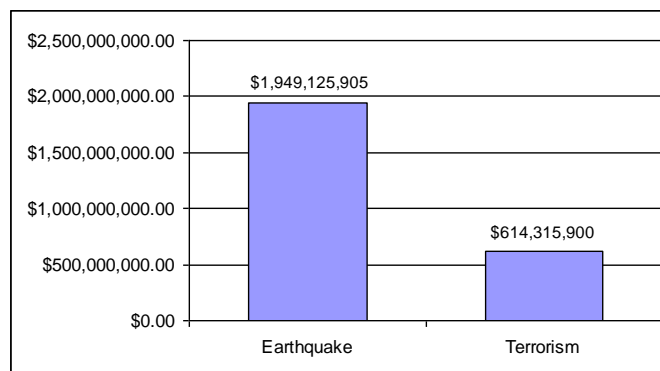
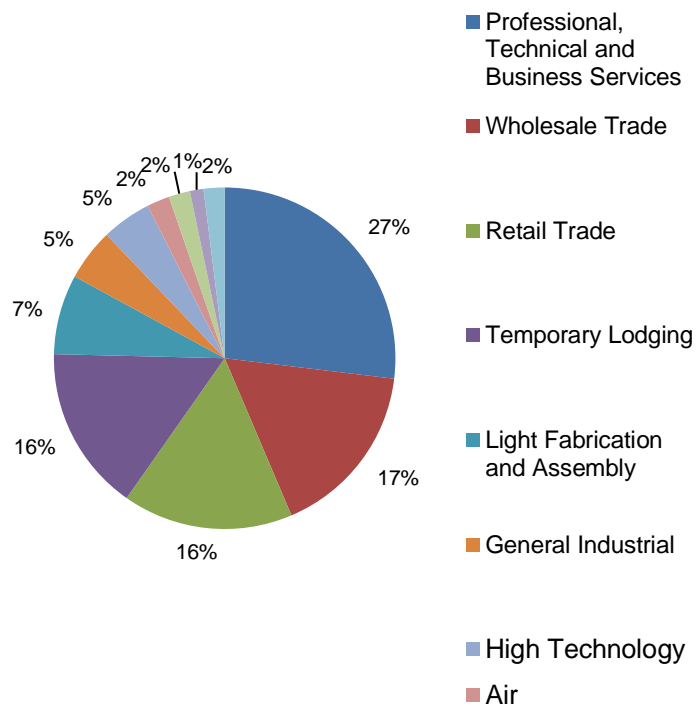


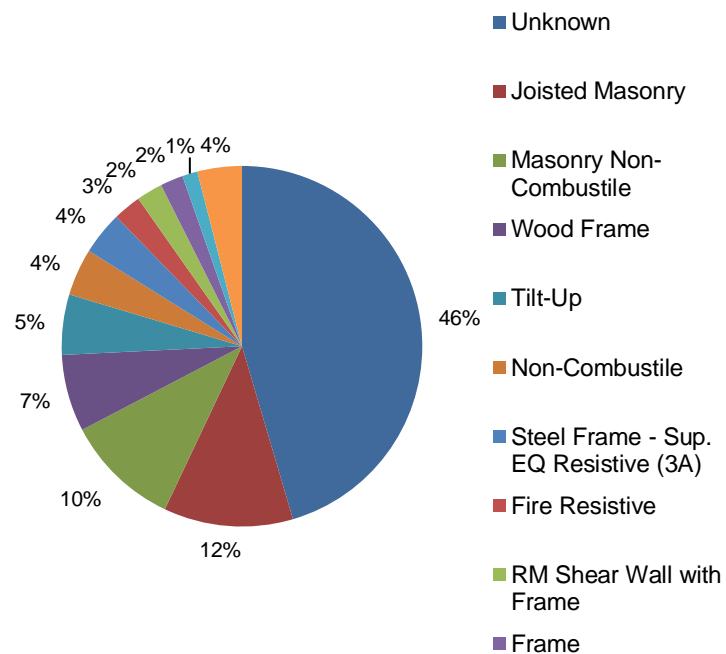
Figure 1 displays the aggregate composition of the entire portfolio broken out by key modeling parameters. The portfolio is primarily a mixture of commercial and industrial occupancies with a majority of masonry construction and 71% unknown year built. Where specified, the year built is of a typical distribution for the region.

Figure 1: Exposure Characteristics of COMPANY A portfolio as a percent of total insured value

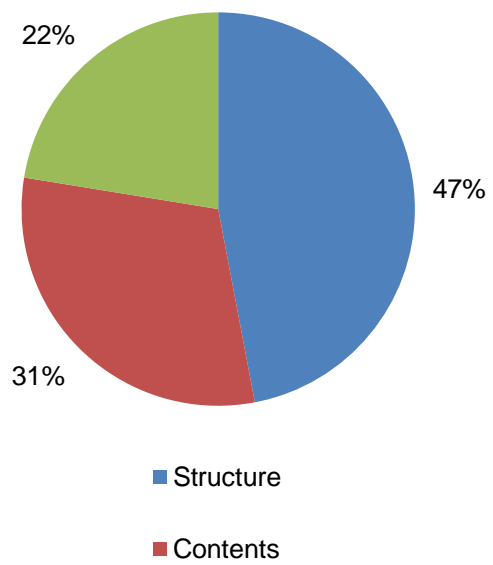
OCCUPANCY



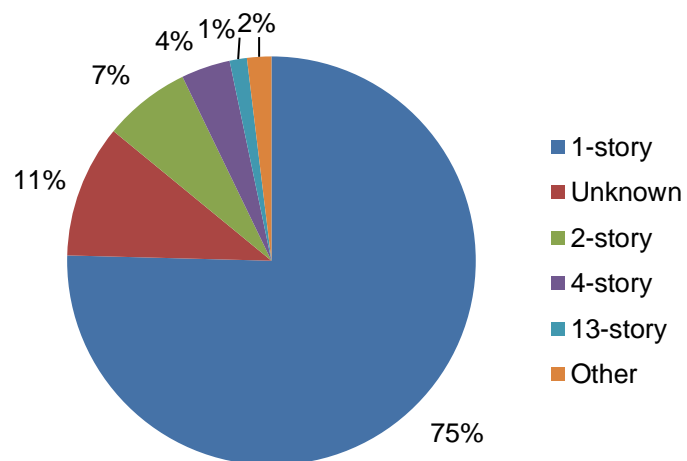
CONSTRUCTION CLASS



COVERAGE



HEIGHT



Exposure Data Description

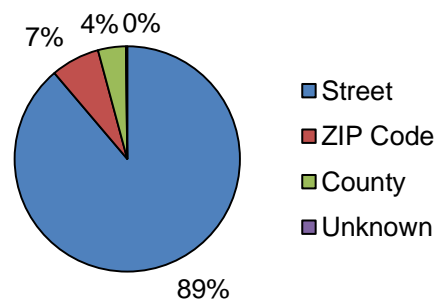
Data format	DQ_CAEQ_EDM.mdf
Vintage	September 2018
Description	California Commercial Property book

From a review of the information contained in Figure 1, it is noted that the percentage of exposure with unknown construction class is 45%. This is an appreciably high percentage for a commercial book and should be lowered.

The majority of the book (~75%) is 1-story. It is important to note that ~40% of the 1-story buildings are coded with unknown or default construction. The construction inventory table lookup in this case will be constrained to the average construction for 1-story buildings for the coded occupancy. It is important to verify that the 1-story designation is not a data assumption.

With respect to the breakdown of exposure by height, the unknown default selection is chosen for ~11% of the exposure. This is a somewhat acceptable percentage for a commercial book. It is recommended that efforts be applied to reduce this percentage down to less than 5%. Selecting unknown in this case results in an inventory table lookup of the average number of stories for the combination of parameters selected. For a commercial book the number of stories can vary greatly therefore the actual number of stories needs to be entered to appropriately characterize the risk exposed.

The geocoding resolution for the portfolio is characterized by the chart below. It is beneficial to have the highest level of resolution possible as it leads to a higher modeling accuracy. With this in mind, the ~89% of exposure coded to street level is expected to yield more accurate results than the remaining ~11% coded at the unknown, postcode and county resolution. RMS has found this level of geocoding resolution to be an acceptable target for commercial insurers.



Claims Data Description

Data format RiskLink EDM

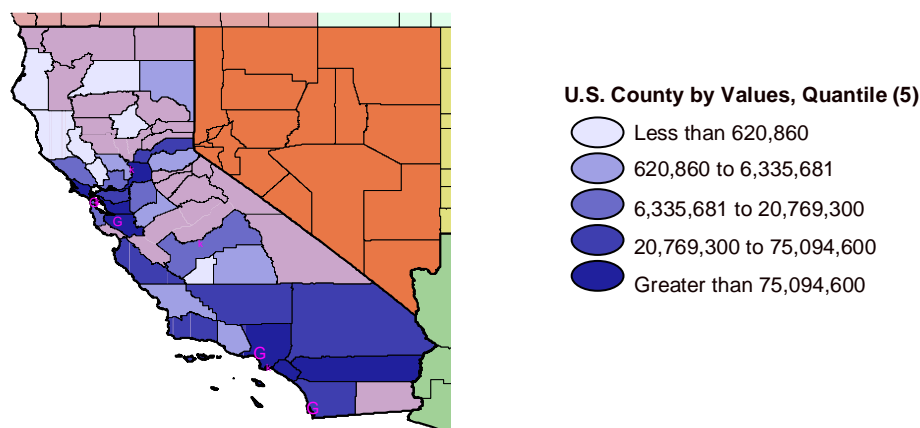
Vintage October 30, 2018

Description 71 claims, with total incurred losses of ~\$77.1 million;

Of the 71 account level claims listed, only 23 entries had non-zero incurred losses. Adjuster's expenses were listed separately and are not included in any of the analyses since they are not included in the model results.

Geographic Extent of Analysis

The COMPANY A California book of business is composed of locations throughout California. As seen in the chart below, the majority of the exposure lies in Southern California, with significant representation in the San Francisco/Bay Area. In aggregate, this represents a regionally undiversified portfolio to California earthquake risk. Over 57% of the portfolio exposure is evenly distributed in just 4 counties: 2 counties in Southern California (Riverside and Los Angeles) and 2 counties in the San Francisco/Bay Area (Santa Clara and Alameda).



Following an event scenario or an event footprint analysis, it is possible to quantify the exposure to the event. The table below shows the distribution of the exposure to the Puente Hills Earthquake and incurred losses. Based on this analysis, approximately 45% of the California commercial portfolio insured value was exposed to this event.

Event	Event Exposure	% of Portfolio TIV	Incurred Gross Losses
Puente Hills M 7.1	\$876,325,700.00	45.04%	\$13,878,214.92

Key Data Preparation Assumptions

RMS has reviewed and made assumptions about and adjustments to the claims and exposure data. Table 1 and Table 2 list the assumptions and provide a scale of the approximate relevance to modeled losses and incurred losses. Although relatively few modifications were made to the COMPANY A California commercial data, the tables are included to provide an overview of the typical steps undertaken in the claims analysis process to review and in some cases clean up exposure and loss data. It is important to note that additional adjustments are typically carried out by RMS when processing data sets containing location level claims. However, when only policy level information is provided there is less of a basis to make assumptions on in an effort to make a more accurate apples-to-apples comparison. For a more detailed description of how these adjustments were made see Appendix B.

Table 1: Summary of Assumptions and Adjustments to COMPANY A California Exposure Data

Assumption or Adjustment	Description	Adjustment to Model Losses
Data vintage	The EDM supplied by COMPANY A was for September 2018 and therefore is assumed to be an adequate description of the number of risks. Over 97.0% of the claims data was matched to the exposure database, confirming the adequacy of the exposure data.	None
Exposure excluded from the analysis	No exposure data was excluded in this analysis.	0%
Insurance to value	An adjustment to coverage values policies is sometimes necessary based on information supplied by individual insurance companies. Coverage values were adjusted for COMPANY A by 10% for commercial based on building value market adjustments in the past year.	+10%
Coding of exposure characteristics	RMS reviewed the composition of the exposure database and found no significant systematic concerns related to coding of construction type, occupancy, year built, the resolution of geocoding or the number of stories. However, there are exposure quality issues that were revealed through the account level analyses.	None
Use of VRG footprints	All analyses in the report are based on the VRG footprints.	None

Table 2: Summary of Assumptions or Adjustments made to Claims Data

Assumption or Adjustment	Description	Adjustment to Observed losses
Open claims	90% of claims remained open at the time of this analysis. Reported incurred losses include reserve amounts for all open claims. RMS has treated reserved losses as closed claims, assuming that the final closed amounts will not be substantially different.	None
Ignored claims	Occasionally claims that are unrelated to earthquake damage are excluded from the analysis. No claims were ignored in the COMPANY A analysis for this reason.	0%
Linking claims and exposure data	A small amount of claim accounts were found to have no corresponding entries in the exposure database. RMS has ignored these claims. It is possible that there are also locations that incurred no loss that are missing from the exposure database; however no adjustment to the exposure database is made assuming that the missing zero-loss exposure locations occur in proportion to the missing claims.	-5%
Replacement cost value	RiskLink outputs loss estimates on a replacement cost value (RCV) basis. COMPANY A representatives supplied the information that all claims were assumed paid at RCV, therefore no adjustment had to be made to claims data.	None

Gross Incurred and modeled losses before and after making the adjustments in Table 1 and 2 are summarized in Table 3. At this level, the model underestimates gross losses by ~14% in aggregate. Contributors to this difference, such as demand surge, must be incorporated in the model losses before a more direct comparison can be undertaken. These differences are quantified and discussed in the next section.

Table 3: Summary of Gross Model-Incurred before and after adjustments to raw data has been made.

Claims Data		Model Data			
Incurred Loss as Supplied by Client	Modified Incurred Loss	Model Before Adjustments	Model After Adjustment	% Difference Model / Incurred Before	% Difference Model / Incurred After
\$16,931,422	\$16,084,851	\$13,878,215	\$14,108,034	22%	14%

Note: 1. Claims data inherently includes demand surge, but model results do not at this point in the analysis. 2. Details of adjustments and assumptions made to data are summarized in Appendix B and Table 11 and 12.

3. Model to Incurred Loss Ratios

The non-modeled losses (e.g. falling trees) and losses outside the footprint were factored out or removed from the claims data to facilitate a review of the gross modeled to incurred losses. The magnitude of these loss escalation factors and the change in the gross model to incurred loss ratios when these sources of loss are excluded are shown in Table 4.

Table 4: Quantification of key drivers of loss escalation included in claims data that do not appear in model results

Incurred Claims (Gross)			Model Results (Gross)			% Difference Model/Incurred Losses (Gross)	
Modified Incurred Loss ¹ (A)	Outside Footprint	Inside Footprint (B)	Model After Adjustment (C) ²	Add Demand Surge	Model Estimate (D)	C/A	D/B
\$16,084,851	\$0	\$16,084,851	\$14,108,033	\$1,692,963	15,800,997	88%	98%

Notes: 1. From Modified Incurred Loss column in Table 3

2. From Model After Adjustments column in Table 3.

When demand surge and other escalation factors are included, the percent difference between model-incurred losses improves from 12% to 2%.

4. Account Level Analysis

Total losses in the Puente Hills earthquake were concentrated in a relatively few number of accounts. Table 5 lists the 20 accounts that collectively sustained all of the COMPANY A incurred loss for the Puente Hills Earthquake. Approximately 85% of the gross incurred loss for the event is represented by losses from six accounts.

Table 5: Account level distribution of exposure and incurred loss

INSURED NAME	Incurred Loss	% of Total Incurred Loss
ACC_97	\$3,012,305	21.71%
ACC_77	\$2,215,602	15.96%
ACC_4852	\$1,713,199	12.34%
ACC_59	\$1,121,625	8.08%
ACC_21	\$939,653	6.77%
ACC_96	\$714,608	5.15%
ACC_79	\$553,304	3.99%
ACC_69	\$442,517	3.19%
ACC_28	\$441,790	3.18%
ACC_12	\$432,870	3.12%
ACC_23	\$415,634	2.99%
ACC_63	\$301,715	2.17%
ACC_8	\$230,513	1.66%
ACC_94	\$225,455	1.62%
ACC_75	\$214,864	1.55%
ACC_17	\$179,766	1.30%
ACC_58	\$179,639	1.29%
ACC_80	\$159,135	1.15%
ACC_102	\$149,036	1.07%
ACC_67	\$117,540	0.85%

For the top two loss causing accounts, account level analyses were performed to flush out key issues related to model performance. It is important to note that these are the highest loss accounts and therefore fall towards the extreme end of modeled loss distributions. Therefore, it would *not* be expected that the model would precisely estimate losses for each of these individual accounts. If it did, then most likely the model would be overestimating losses on all other accounts. However, the model should be capable of modeling the variability inherent in commercial claims loss distributions such that on a portfolio basis there is not a bias on the low or high side. The benefit of reviewing individual accounts is the considerable insight that can be gained related to specific modeling issues as well as best practices for using the model.

Note: Continuation of this section not included

Appendix A. Puente Hills Earthquake Overview

The Puente Hills fault is a mapped active thrust fault in Los Angeles County, California. A magnitude 7.1 earthquake occurred on the fault on September 7, 2018. Industry losses are expected to be \$340 billion.

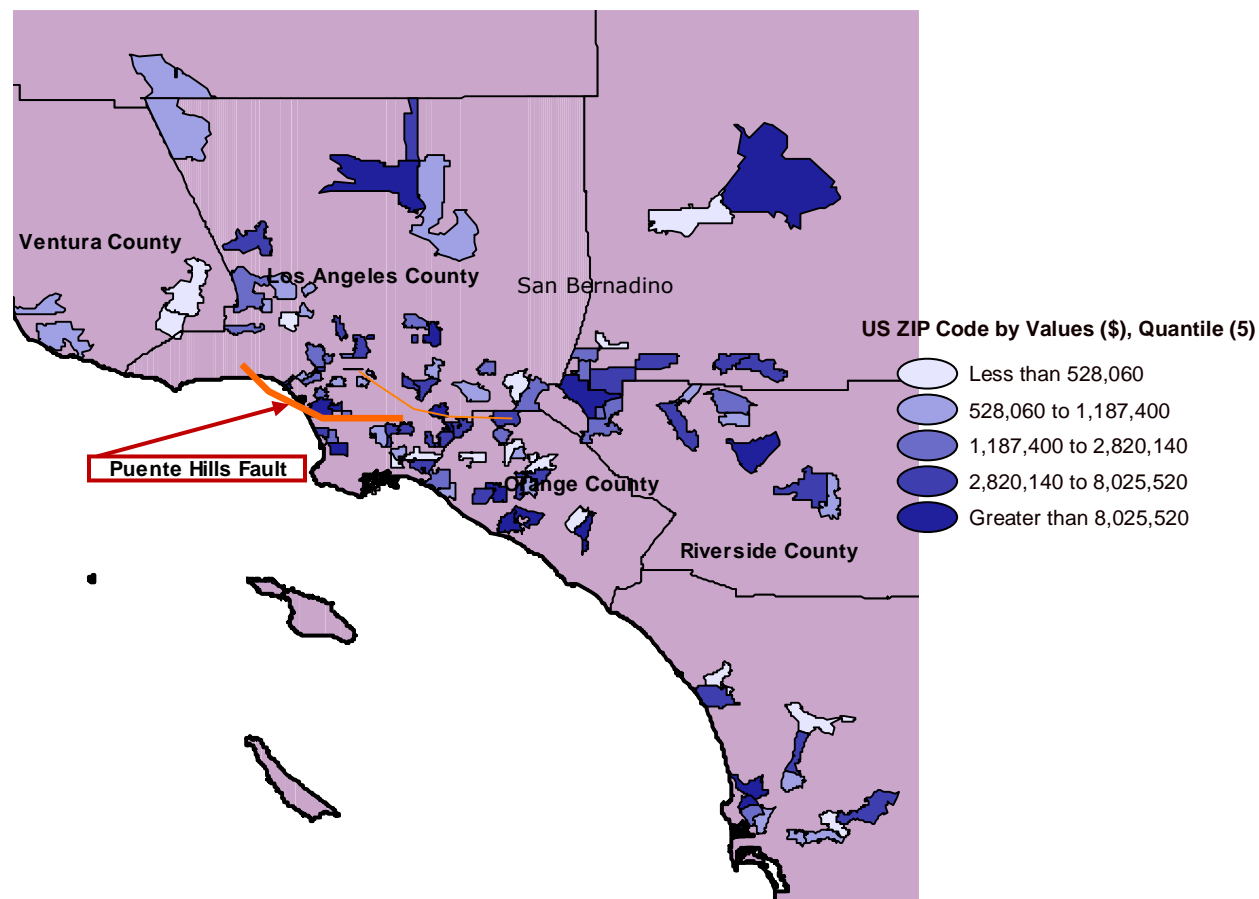


Figure 9: Map of Puente Hills fault surface trace and COMPANY A California commercial portfolio ZIP Code aggregate exposure

Appendix B: Analysis Assumptions

This section provides the details of any assumptions or adjustments that were made to the exposure or claims data to prepare the data for model to incurred loss comparisons. This section contains all the details behind how and why the assumptions or adjustments to data were made in Section 2.

Exposure Data Assumptions

Vintage of Exposure

If the exposure database supplied by the client is not within an acceptable time frame of the events that are being analyzed, then RMS will make efforts to recreate an appropriate list of exposed locations from one or more sources of data supplied by the client. The model comparisons will be most relevant when the exposure database is an accurate representation of the actual locations exposed to the earthquake.

The EDM supplied by COMPANY A was based on in-force policies for a September 2018 perspective. The vintage of this data is just before the Puente Hills earthquake, and therefore is considered an adequate representation of the number of risks affected by the earthquake. We also verified this by checking how many of the claims locations could not be matched to the exposure database. For this data set, the amount of claims locations that could not be matched was less than 9% of the locations overall, which gives us confidence that the exposure database is a timely representation of the book.

There are 24 expired policies and one policy with a cancelled status, but with an in-force expiration date.

No adjustment to the quantity of exposure locations was necessary.

Exposure Excluded from the analysis

Occasionally, exposure data will be received that cannot be used in the analysis for a variety of reasons including duplicate locations, or policy types that are not reflected in the claims data. If so, this data is typically set aside from the model to incurred comparisons.

For COMPANY A, none of these situations is applicable, and therefore no data has been ignored in this analysis.

Data Quality: Adjust for Insurance to Value

The fundamental assumption of all RiskLink and RiskBrowser models is that the coverage values are entered in the model as full replacement cost values. Exposure data that is undervalued will yield correspondingly low loss estimates. Therefore, it is important to correct exposure data to fully reflect the full replacement value of each modeled risk. No such corrections were made for the COMPANY “A” portfolio based on comments regarding the use of valuation tools used to insure values are maintained on an RCV basis.

Data Quality: General Coding Issues

RMS has reviewed the exposure data received from COMPANY A to check that the data is coded appropriately for the software analysis. This review is accomplished by summarizing the portfolio in a variety of manners including a comparison to our industry exposure database.

Within the RMS North America Earthquake Model, there are a wide variety of occupancy, construction type, height, and coverage selections. There are also defaults referred to as “unknown” that the user can select. If Unknown is selected, then the model will make an engineered “best guess” of what parameter to use. For construction class, the model will look-up the geographic area for the particular risk being modeled and selects an inventory mix of construction types. RMS recommends that “Unknown” be avoided if better information exists.

Secondary modifiers help refine loss estimates when site specific information is known. For locations where additional information is available, RMS typically recommends that secondary modifier information be collected and included in the EDM to improve modeling accuracy since this allows the model to take advantage of site-specific conditions to further refine the loss estimate.

Claims Data Assumptions**Treatment of Open Claims**

The claims data for COMPANY A was of vintage December 2018, which is 3 months after the earthquake. RMS has noted that there are still numerous claims that remain open. As shown in the table below, as a fraction of the number of account level claims, the percentage of open claims is ~41%. COMPANY A has supplied an incurred loss, which includes estimates of reserves on open claims as well as the paid losses which are amounts that have been paid out on closed claims. Although over half of the claims are listed as open, there are only 13 that have non-zero reserve estimates. It therefore seems likely that a portion of open claims are in fact closed.

Table 6: Number of Claims related to COMPANY A Portfolio

Number of Claims	Percent Closed
71	59%

In this report, the analyses have been completed primarily on the total incurred loss, assuming that it is a realistic estimate of the final losses that will be incurred. Given the significant number of claims yet to be closed there is a possibility that the actual claim amount may settle at a much different value than reported here, affecting the model to incurred comparisons.

Ignored Claims Data

Within some claims data sets there is a portion of claims that are ignored from the analysis due to a variety of miscellaneous reasons. In the COMPANY A claims data set, no claims were ignored.

Linking Claim Locations to Exposure Assumptions

Normally, in some claim and exposure data sets that are written by a primary carrier and are analyzed by RMS, a considerable amount of time can be spent on matching the claim location to a location within the exposure data. The figure below graphically displays the relationship between claims and exposure, when location level claims are available, in order to achieve an appropriate modeled versus incurred loss comparison. For those data sets that write highly layered policies and report claims only on an account basis, the analysis is forced to match the claims to the EDM based only on an account basis. This level of matching allows RMS to determine the degree to which the EDM is missing exposure information, but prevents RMS from characterizing the amount of loss outside the footprint.

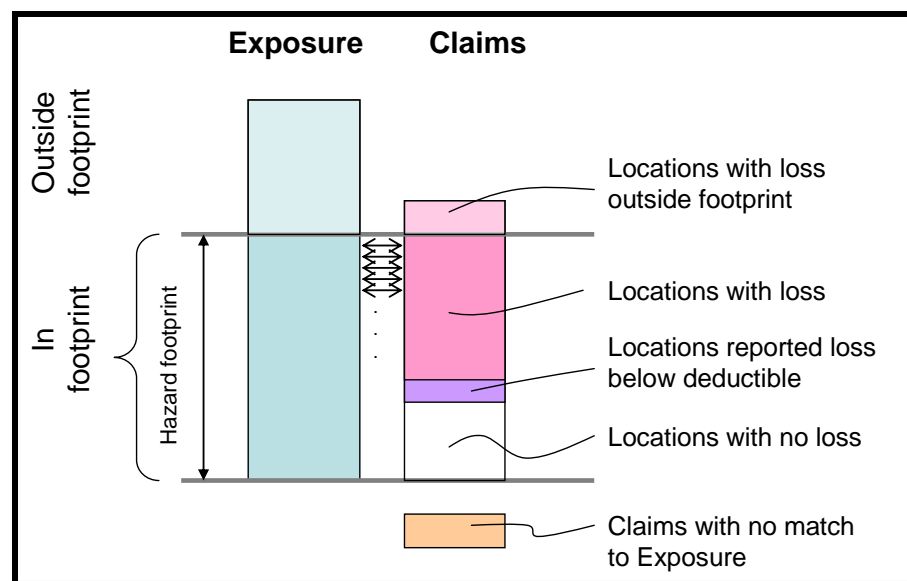


Figure 12: Illustration of how exposure and claims data fall within and outside the event footprints

In performing claims analysis work for this data set, RMS has found that a certain fraction of claims information typically will not map to any valid locations in the exposure database. This is usually related to the vintage of the exposure data relative to the event date. For this data set, the vintage was September 2018, and the fraction of the claims that ultimately could not be matched to the exposure database was approximately 9% of the locations overall, representing only 6% of the incurred losses. When ignoring these unmatched claims, it is also assumed that there is an appropriate amount of missing exposure that had no losses. Thus no adjustments to the exposure are necessary as a result of ignoring these claims. A 91% match to the EDM overall is considered adequate and gives us confidence the exposure database is a timely representation of the book.

Adjusting Losses to Replacement Cost Value (RCV)

The RMS North America Earthquake model assumes that the values entered are at replacement cost value (RCV), and modeling output assumes settlement on a corresponding replacement cost basis. After discussions with COMPANY A personnel, it was determined that the loss data reported to RMS was RCV for all claims. RMS has also assumed that no hold backs, if applicable, were removed from the claims information supplied by COMPANY A. Therefore, no adjustment to the claims data was necessary.

RMS requested a sampling of claims files to confirm this assumption, and found that the assumption appears valid (as well as to provide a custom perspective on demand surge).ria