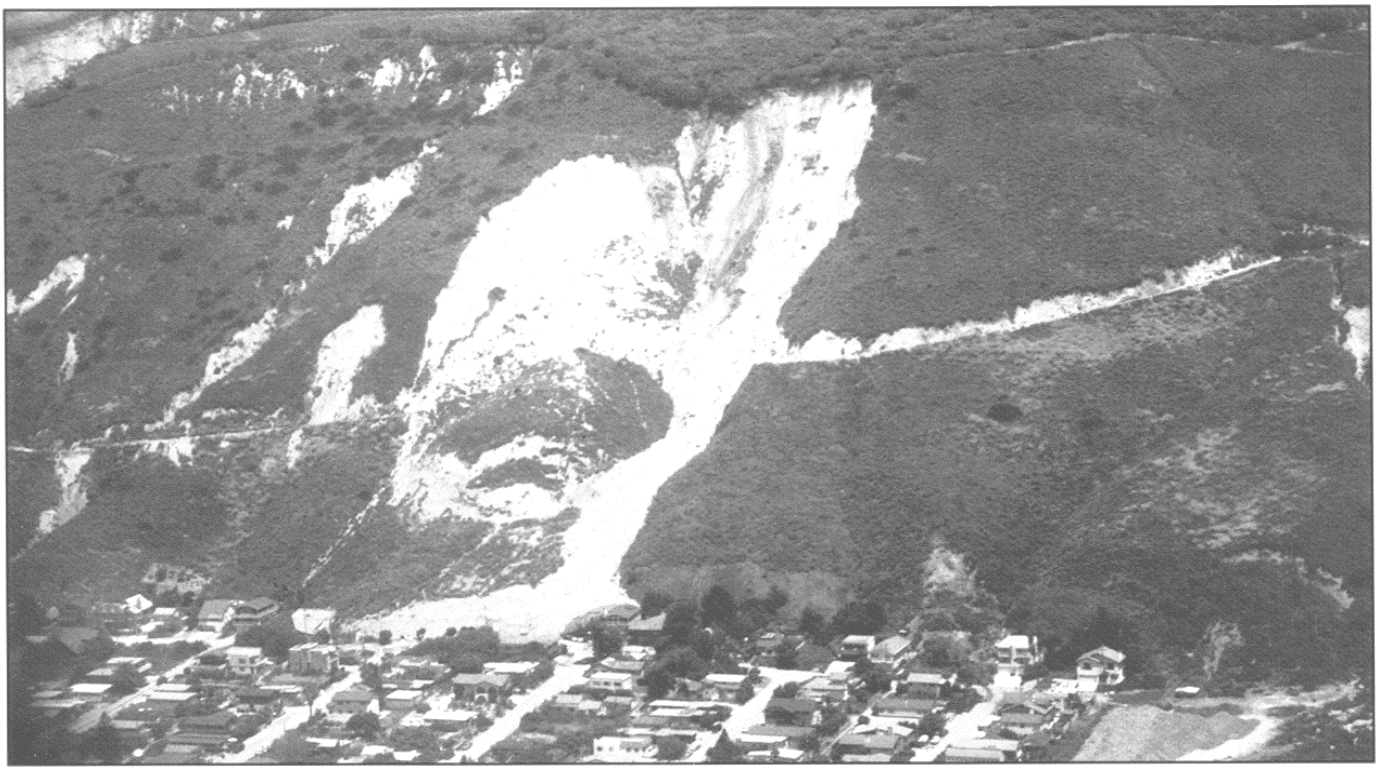
AMERICAN ASSOCIATION OF STATE GEOLOGISTS

LANDSLIDE LOSS ESTIMATION PILOT PROJECT

CALIFORNIA LANDSLIDE LOSSES

USGS Order # 01HQSA0318



By
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October 17, 2002

COVER PHOTO: La Conchita landslide, Ventura County. The known-to-be-active La Conchita landslide buried six homes and destroyed three others on March 4, 1995. Because the community had been notified of the potential for failure and the county had implemented an emergency response plan, no lives were lost. *Photo courtesy of Chris McCullough, California Department of Conservation, Division of Oil, Gas, and Geothermal Resources.*

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Introduction to Survey

The Association of American State Geologists surveyed its membership regarding the occurrence and distribution of landslide damage to residential properties during the El Niño year, 1997-98. The outcome of that survey indicated that there are very few formal public records available that provide information on the repair and replacement costs for landslide damage to residential property. When landslides occur during disaster situations, landslide damage is often included into flood or earthquake damage categories.

In an effort to design a low-cost and effective way of collecting this type of landslide loss information the Association, with partial funding from the U.S. Geological Survey, established a pilot program to survey landslide-prone areas in each of seven participating states. Each state polled selected government agencies to determine what kinds of permitting processes they have in place for collecting data, and how that information might be used for tracking the annual costs associated with landslides.

Purpose and Scope:

There is a lack of accurate and readily available cost data for single-family dwellings that suffer damage from landslides. Our purpose is to identify landslide costs from the data collected during the permit process so it can be tabulated and estimated more accurately on a timely basis as properties are being repaired.

The scope of this investigation consists of a summary of the landslide cost estimates that have been made retroactively by state and federal agencies for affected residential homes, a review of various building and grading permit procedures at the local level and followed up telephone interviews with cities and counties. To back up the building permit reviews, individual web sites were examined for permit information, then cities with the most complete information were contacted to see how they might incorporate landslide damage estimates into their permit processes.

Our main contribution to the Landslide Pilot Project is a survey of the building and grading permit information that is currently being collected and an analysis of how these data might be used to estimate annual landslide losses. On page 15-17, we develop a simple model to show how landslide data can be collected from existing building permit fields and propose some additions, opportunities and limits for future use.

Background:

It is estimated that California landslides cause more than $100 million in losses and kill five people each year (Brabb, 1989). However, those losses can vary dramatically from year to year (see Figure 1). The reason most estimates are made retroactively is that public agency cleanup following severe winter storm periods often qualifies for federal and state disaster aid. In the past, some landslide damage information has been available through the aid programs after declared disasters

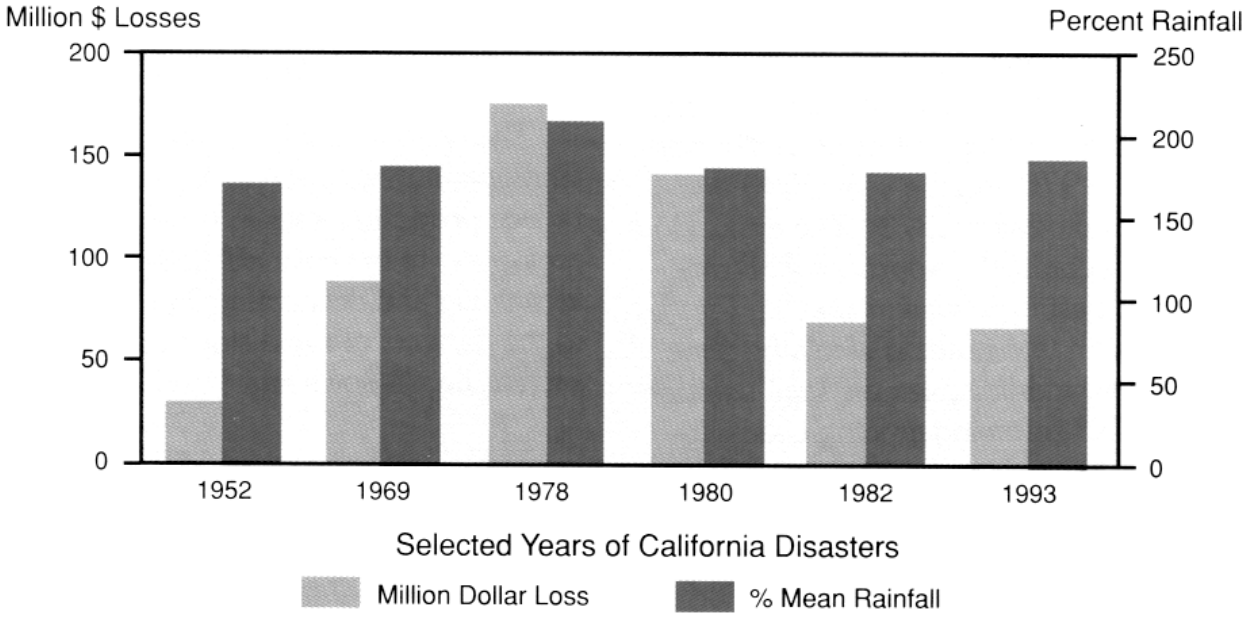


Figure 1: Property losses (shown here with rainfall) gathered from various sources indicate that storm damages varied between $25 and $170 million for the years selected. (Barrows, 1993)

The long, north-south linear coast of California presents the coastal mountain ranges as a barrier to winter storms moving onshore from the ocean off Alaska and Mexico. Annual precipitation in the coastal belt ranges from more than 100 inches in the north to less than 15 inches in the south. Much of the annual damage from landslides in the state occurs in response to intense periods of high rainfall during storm events or after prolonged above-average precipitation. The typical pattern of landslide susceptibility shown in the Urban Geology Master Plan (Alfors and others, 1989) indicates that damage is generally concentrated within 100 miles of the coast (Figure 2). The widespread storms of 1995 and 1998 show a similar pattern of damage occurred in the state (Figure 3-4). The last two damaging earthquakes triggered landsliding, but in a more restricted area than storms so those losses are only discussed briefly in this study. Some of the identified threats to slope stability include steep slopes, weak rock and slope destabilization related to earthquakes, rainfall, grading, development, logging and road building.

Figure 2: Generalized Pattern of California Landslides
Source: Alfors and others, 1973

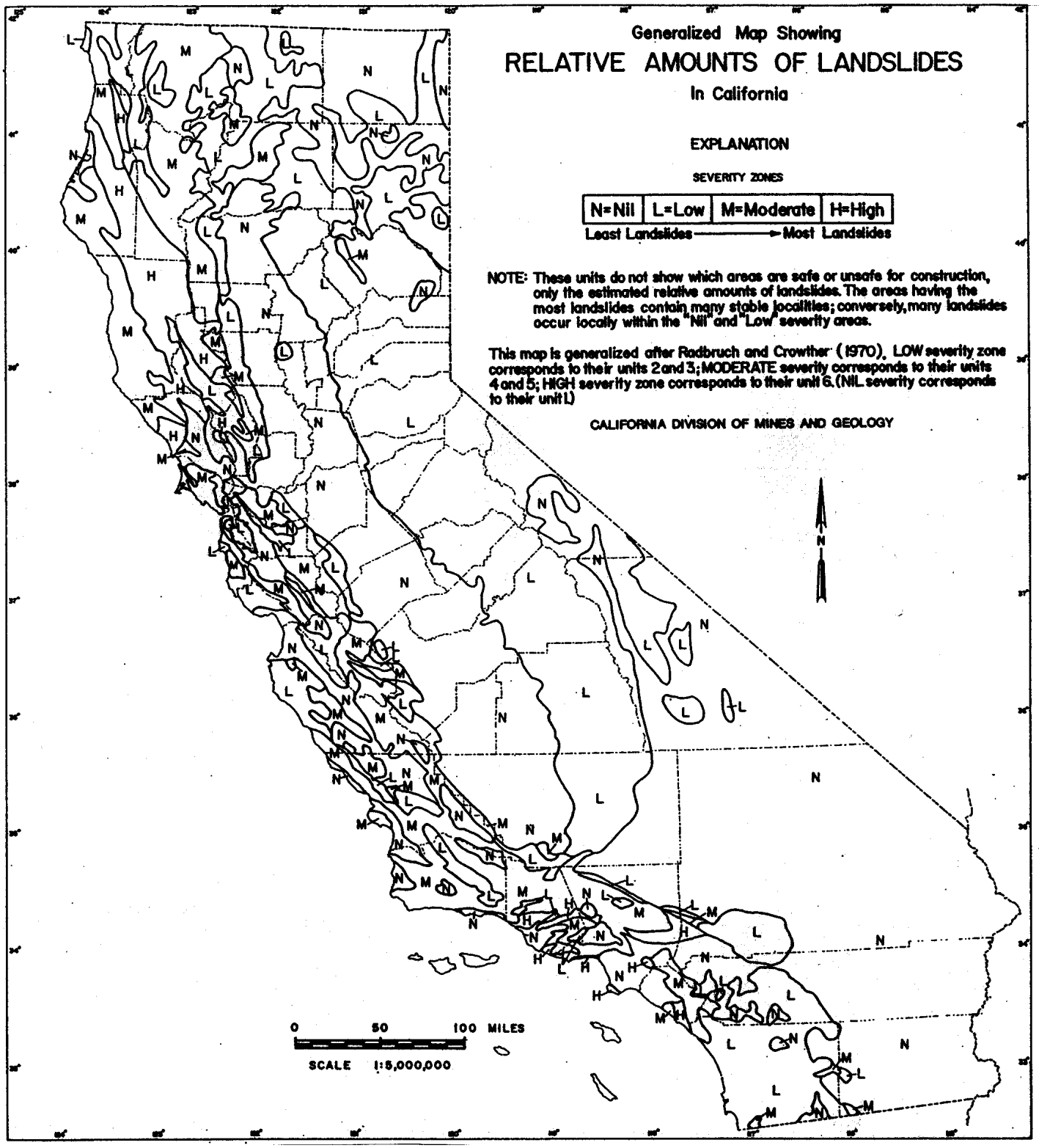
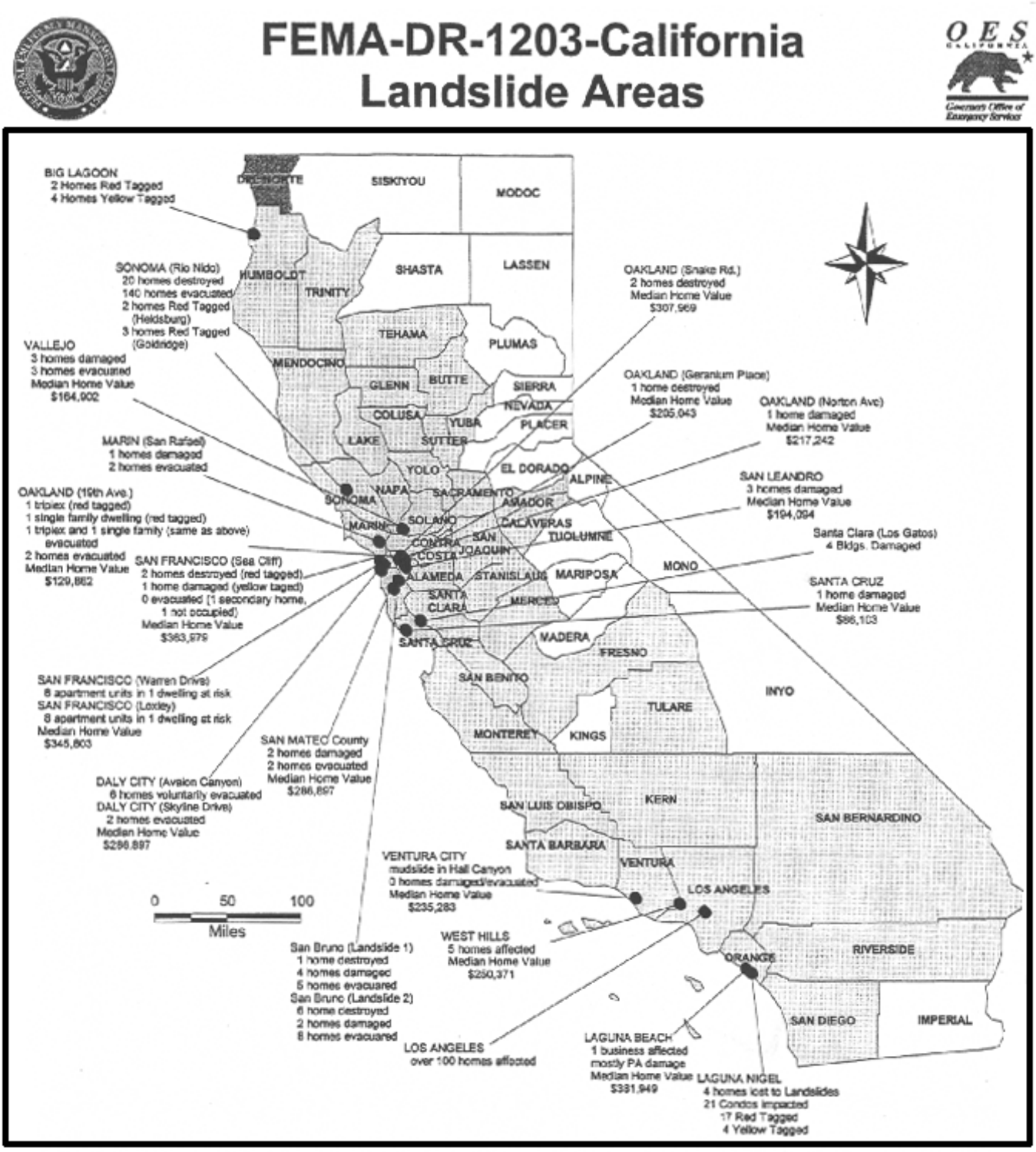


Figure 3: 1995 Storm Damage Pattern:
Source: California Geology, 1996

1. Hollywood Hills
2. Malibu
3. Niles Canyon
4. Cloverdale
5. Los Gatos
6. San Anselmo
7. Yager Creek
8. Placerita Canyon
9. Verdugo Mountains, Glendale
10. Placerville to Lake Tahoe
11. Redwood Estates, Highway 17
12. La Honda
13. Carl's Slide, Willits
14. Squaw Rock, Cloverdale
15. Redwood Valley
16. Orinda
17. Avenue of the Giants
18. Highway 1, Jenner
19. Petrified Forest Road
20. Calistoga Road
21. San Antonio Creek
22. Petaluma
23. Cazadero Highway
24. Leggett, Highway 101
25. Santa Cruz Mountains
26. Highway 36
27. Sulphur Springs Road
28. Willits, Highway 101
29. Morrison Canyon Road
30. Highway 299, Salyer
31. Highway 1, Point Arena to Garcia
32. Guerneville
33. Highway 299, Burney
34. Mission Boulevard near Fremont
35. Red Bluff, Highway 5
36. Laguna Hills
37. Pescadero
38. San Rafael
39. West Marin, Nicasio
40. Dry Creek, Sonoma County
41. Highway 36, Mad River
42. South Fork Mountain Highway
43. Highway 70, Feather River Canyon
44. Highway 32, Lassen Park Area
45. Highway 299, Burnt Ranch
46. Highway 299, Indian Creek
47. West Santa Monica Mountains
48. Santa Clara River area
49. Highway 23
50. Highway 23, Fillmore
51. Larkspur
52. Highway 1, Scenic
53. Soquel Creek
54. Highway 299, near Trinity/ Shasta County line
55. Shellville, Sonoma County
56. Highway 140, Yosemite NP
57. Butte County, PG&E canal
58. Highway 101, Healdsburg
59. Highway 121, Sonoma/ Napa County line
60. La Conchita, Ventura County
61. Santa Monica
62. Highway 16, Yolo County
63. Rim Forest, San Bernardino County
64. Russian River, Sonoma County
65. Freezeout Creek Road, Sonoma County
66. Brentwood, Los Angeles County
67. Mission Viejo, Orange County
68. Lake Berryessa Highlands
69. Morro Bay, San Luis Obispo County
70. Coalinga, Fresno County
71. Redlands, San Bernardino County
72. Peabody Road, Solano County
73. Gualala, Mendocino County
74. Highway 29, Napa County
75. Cambria, San Luis Obispo County
76. Highway 116, Sonoma County
77. Pacific Palisades, Los Angeles County
78. Redway, Humboldt County
79. Navarro River, Mendocino County
80. Highway 49/Brandy City Road, Sierra County
81. Diamond Bar
82. Big River
83. McDonald Creek
84. Snow Creek, Siskiyou County
85. County Road 336
86. Big River, Russell Brook
87. Railroad Gulch, Humboldt County

Figure 4: 1998 Storm Damage Pattern: Shading indicates counties eligible for Individual and Public Assistance as of March 6, 1998.
Source: Interagency Hazard Mitigation Team Report, 1998



Jurisdictions Contacted:

The following agencies were contacted or surveyed as part of this project:

Table 1: Jurisdictions Surveyed

Federal Agency:
FEMA--- Daryl Wait, Emergency Management Officer, Region IX
State Agency:
Department of Transportation, James Varney, Major Damage Eng
Office of Emergency Services, Michael Sabboghian, IT Support
Local Jurisdictions:
Laguna Beach – John Montgomery, Community Dev. Dir
Los Angeles –David Hsu, Chief Grading Inspection
Los Gatos – Bud Lortz, Community Development Director
San Jose – Mike Shimamoto, San Jose City Geologist
San Jose—Larry Wang, Chief Plan Check Engineer
Oakland – Joan Curtis, Senior Engineering Technition
Santa Clara Co – Jim Baker, Santa Clara County Geologist
Ventura Co – Jim Otusa, Ventura County Geologist
In addition, Building and Grading Permits were examined from:

CITY	TYPE OF PERMIT REVIEWED		
	Building	Grading	Trade*
Anaheim		x	
Berkeley	x		
Concord			x
Laguna Beach	x	x	
Laguna Niguel	x		
Los Angeles Co		x	
Los Angeles City	x	x	
Los Gatos	x	x	
Malibu	x	x	
Mission Viejo	x	x	
Mountain View			x
Oakland			x
Orange Co	x	x	
Orange City		x	
Rolling Hills		x	
San Francisco			x
San Jose	x		x
San Juan Capistrano		x	
Santa Clara Co	x		
Santa Clara City	x		x
Santa Clarita	x		
Sunnyvale		x	x
Tustin	x	x	
Ventura Co	x		

* “Trade” permits are issued for minor electrical, mechanical, plumbing and re-roofing work.

Criteria for Selecting Jurisdictions:

In the past six years, CGS staff have met with more than 130 cities that were zoned for landslides under the Seismic Hazards Map Act and collected a variety of local building and grading permits forms and municipal codes. That material was reviewed to determine what triggered the permits and what kind of information they contain that could be used for estimating landslide losses. Using our knowledge of historical damage patterns, landslide susceptibility and local permit, grading and inspection practices, we selected cities that might have landslide damage information summarized in their permit data.

CGS Findings from Survey of State and Federal Agencies

In California a number of different agencies and departments collect landslide data for emergency response, land use planning purposes and to ensure safe construction standards. This is a summary of some of the methods used by these agencies and some of the limitations of that data when it is used to compile annual landslide loss estimates for residential property.

Federal Emergency Management Agency:

The Federal Emergency Management Agency (FEMA) administers a number of grant programs through the State Office of Emergency Services (OES) for disaster relief and mitigation. There are two that apply in this study. The Hazard Mitigation Grant Program (HMGP) is funded by an amount equal to 15% of the federal funds spent at each disaster for new mitigation projects that are cost-effective and substantially reduce the risk of futures damage, loss and suffering. Eligible applicants are state agencies, local governments and private non-profit organizations. Two challenges arise in using FEMA related information to determine landslide damage costs: 1) funds are administered through State and local governments, so several sources may have to be searched, and 2) landslide damage to structures is difficult to distinguish from landslide damage to residential and other structures.

The Individuals and Households Program (IHP) is a source of FEMA funding that relates specifically to residential losses. Under the original provision of section 408 of the Stafford Act, there was no cap limiting assistance for owner-occupied private residences. In the amended version adopted October 30, 2000 the grant funding available for private homes is capped at $15,000 per applicant ($ 5,000 for repair of owner-occupied private residences, utilities and private roads and $ 10,000 for replacement costs). The latest Federal rule that applies to individual assistance went into effect on September 30, 2002 (Fed. Reg. Vol. 67, No. 189) and reaffirmed the $15,000 limit for Individuals and Households Program. The severe limits on funding makes this program of limited use for compiling retroactive landslide losses.
Most of FEMA's landslide disaster work has been directed toward reimbursing public agency emergency work. However, in February 1998, forty-one counties

in California were declared eligible for disaster assistance under FEMA-1203-DR because of the extensive damage from El Niño winter storms and flooding. A large portion of the damage was related to landslides and a number of private residences were damaged or destroyed. OES and FEMA used a combination of grant programs to prioritized volunteer cities and individuals for aid in acquiring property impacted by slope instability.

The State and local participating cities compiled a list of homes that were damaged by landslides in 1998 and subsequently "bought out" or acquired the property using supplemental federal funding using a 75% federal: 25% state/local split. The grant program resulted in 165 acquisitions at a federal cost of over $22 million. When the State and local costs are added in, the total cost of these acquisitions is $30 million. This tabulation indicates that direct losses to housing represent ***at least 30%*** of the average $100 million annual losses from all landslide damages in the state estimated by Brabb (1989). The following table shows the funding recipients and the 75% federal share of the cost of acquiring the properties (see Table 2).

Table 2: Property Acquisitions: using partial (75%) FEMA funding

1998 El Niño Storms Disaster (FEMA - DR #1203 - CA)		
Jurisdiction	**# of Properties**	**FEMA/Federal Grant portion**
County of Sonoma	44	$ 3,400,000.00
City of Laguna Niguel	32	$ 6,000,000.00
County of Humboldt	17	$ 1,300,000.00
County of San Mateo	11	$ 1,200,000.00
City of Los Angeles	10	$ 2,400,000.00
City of Pacifica	10	$ 1,200,000.00
County of Monterey	10	$ 1,500,000.00
County of Santa Cruz	10	$ 1,900,000.00
City of Santa Barbara	7	$ 1,100,000.00
County of Los Angeles	4	$ 860,500.00
City of Oakland	4	$ 310,000.00
City of Daly City	2	$ 254,000.00
City of Laguna Beach	1	$ 124,400.00
City of Santa Paula	1	$ 126,000.00
City of Berkeley	1	$ 216,100.00
County of San Benito	1	$ 348,000.00
TOTALS:	**165**	**$ 22,239,000.00**

The Federal Emergency Management Agency's digital database is built from Damage Survey Report estimates made after disaster events. The input disaster survey form includes a place to list floodplain and disaster history. However, in a recently revised form (FEMA Form 90-91, Sept. 98), there is no option to indicate whether a landslide caused the damage. Therefore, there is no way to currently retrieve losses related to landslides.

Surveying acquisitions made under the public assistance program is a viable way to track some residential losses. However, the FEMA database has limited access and requires special knowledge in order to extract the information from it (Michael Sabboghian, OES, pers. com. 10/10/02).

State Agencies:

California Department of Transportation (CalTrans):

The California Department of Transportation's twelve district offices estimate the amount of roadwork that will be done during the year in their annual maintenance budgets. Each of the twelve districts in the state has its own maintenance division that prepares a budget to cover road repairs in the geographic area of their district. The districts do this by estimating the cost of regular road maintenance and small landslide removals based on average costs from past years. Much of this work is reported as maintenance cost for normal roadwork repair and does not get documented as a separate landslide cost (James Varney, Major Damage Engineer, Maintenance Division-Sacramento (pers. com. 4/5/02).

The average cost to fix larger slides is allocated from "project" funds. These are sites where slope instability is known and/or highway improvements are scheduled in response to ongoing problems or for improvement. These funds are estimated in a 4-year Plan that is funded by State Highway Account Funds. Very large and extensive slides that occur infrequently are covered by emergency relief funds from the Federal Highway Authority (FHWA). Robert Schuster (1996) reports that landslide maintenance costs for California state highways is more than $15 million per year and contracted highway repairs average $7.3 million per year.

Office of Emergency Services

There have been five disaster declarations between 1989 and 1998 in the state. Three declarations were triggered by severe winter storms: and two that were triggered by earthquakes. The Governors Office of Emergency Services is the states representative in disaster assistance and relief.

Table 3: 1989-98 Declared Disasters

1. The FEMA-DR-0845-CA disaster declaration was in response to the 10/18/89 Loma Prieta earthquake.
2. FEMA-DR-1008-CA was declared on 1/17/94 in response to the Northridge earthquake.
3. FEMA-DR-1044-CA was declared on 1/10/95 in response to the severe winter storms, flooding and mud/landslides.
4. FEMA-DR-1046-CA was declared on 3/12/95 in response to severe winter storms, flooding, mud and landslides.
5. FEMA-DR-1203-CA was declared on 2/9/98 in response to severe winter storms and flooding.

The Office of Emergency Services ran a computer query for us to determine if local highway losses (not including CalTrans landslide losses) to Public Applicants could be collected using the method (see Appendix A). Road failures above the highway are usually referred to as “landslides” and failures below the highway fill are reported as “slip-outs". So, we used these two terms as search criteria for the database query. The query indicates that landslide cost for road slip-outs and landslides to public agencies during these periods totaled $4.97M in 1989, $1.32M in 1994, $5.53 in 1995, and $6.97 in 1998. The average costs to locally maintained infrastructure attributed to landslides was $4.7 million per year for the four declared disasters between 1989 and 1996 (see Appendix A).

When these categories were queried on landslide costs for the1998 winter storms disaster (FEMA-DR-1203-CA) a line item of $3.3 million was found which includes landslide stabilization for 8 houses in San Leandro, $43,600 for a private house in Los Angeles and $44,387 for two houses in Pacifica. In the 1995 winter storm disaster (FEMA-DSR-1044-CA) a line item of $117, 980 was found for La Conchita landslide monitoring. It is unclear if this money can be identified from other public assistance money as residential landslide damage using the current system. This points out a serious limitation to using this database, as private house damages may be included under an unrelated category.

SUMMARY

A survey of the state and federal disaster relief agencies shows that there are severe limitations to using individual assistance and private property damage grants for tracking annual landslide damages. Some of the limitations include:

1) Applicant eligibility for disaster aid does not cover all losses,
2) It is difficult to distinguish landslide damage from highway and other structural damages, and
3) Payment is routed through state and local agencies.

CGS FINDINGS FROM SURVEY OF LOCAL AGENCIES

Road Departments:

County road departments use somewhat the same methods as the state to fund their landslide repairs to county-maintained roads. The annual maintenance budgets cover the average costs for landslides each year. During disaster periods when the cost of repair exceeds their ability to complete the work, they depend upon public assistance funds made available through FEMA and the state Office of Emergency Services.

Special Districts:

Some of the larger special districts that maintain pipelines, electrical transmission lines and other utilities compile landslide information as part of their long term planning and may maintain cost repair information for their facilities. A survey of them is beyond the scope of the study at this time.

Cities and Counties:

From our initial phone survey, we found that most cities contacted do not breakout or track landslide losses on an annual basis. In some of the larger cities the planning departments are responsible for incorporating landslide hazards into the safety element of the General Plan for land use planning. The building department is responsible for building code compliance and inspection and the public works department is responsible for grading inspection and approval and emergency landslide removal and repair. Many cities have separate building and grading permits. Final approval of the building permit is contingent upon a completed grading permit in those areas that require excavation or fill.

In the past the data collected often were not shared among departments or were compiled into different categories. As desktop GIS systems become more common, there is an effort underway to standardize the collection of data into central databases shared by multiple department users at the city and county level. See Appendix B, a survey of current Building and Grading permits in selected California communities.

<u>Anaheim</u>

Historical data: Landslide data are not routinely collected. In 1993, the city of Anaheim experienced a large and widely publicized landslide in the eastern part of the city where homes were valued at $400,000 to $1 million. The landslide affected 57 acres on a north-facing dip slope in upper Miocene marine sandstone and siltstone. The landslide is about 1,300 feet wide by 1,900 feet long (Barrows, 1993). On January 17, 1993, the slide began to move at the rate of about one inch per day. Cracks and fissures developed across streets and

through houses in the heads scarp area. Compression features damaged houses lower on the slope within the landslide. The city evacuated residents from 46 homes and a massive de-watering program was initiated. Once the slide movement was arrested, most the homes were reoccupied. However, three homes were condemned and nine others suffered major damage. Direct losses to the homes were estimated by the city at $4 million. This figure does not include the emergency landslide stabilization costs that may not be retrievable.

Future availability of landslide data: Phase one of the city's permit system went online in December 1999 making their municipal grading code and application forms electronically available on the web. Anaheim requires a hillside grading permit whenever cut or fill exceeds 100CY and 3' high, on slopes > 5:1 or the area is designated "Hillside Area". The grading permit fee is a flat rate charged for either "flatland" or "hillside" grading. Because of this, the grading permit does not have information on the volume of material or construction valuation. Volume information can be found in the plan details. If the form were modified to include volume information, it would be possible to retrieve this information more easily. Additionally, the form could separate grading for repair to landslides from other types of grading. In order for a system to be set up to capture total landslide loss information, building damages would have to be collected in addition to grading costs.

It may be feasible in the future to modify the digital files to capture the appropriate cost figures during the permit stage and allow future tracking of landslide damage to property through the use of information on the grading and building permits.

Oakland

Historical data: The City of Oakland compiled landslide damage estimates after the 1997-98 "El Niño" storm events and we talked with them about their methodology. The building department reviewed the site visits, newspaper accounts and internal budgets for estimates of El Niño storm damage. For some of the smaller repair jobs, the city had to go back and examine site reports and make cost estimates based on brief reconnaissance surveys by city staff members. Both landslide grading repairs and structural loss estimates were made during the survey.

It was found that costs based on building damage and landslide grading alone were poor indicators of project costs because equipment and labor were not documented at the time the field survey was conducted. The estimates of grading expenses were based on a limited site inspection of surficial damages without knowledge of depth of slide or the repair methods that would be required.

Laguna Beach

Historical data: The City has developed a geographic information system (GIS) to help guide community development and respond to emergencies. The City contracted with a private firm to supply them with up-to-date, low-altitude color aerial photo images that enhance the parcel information on the street/parcel base

map. Immediately following storm events, through the use of time-sequenced photos, staff can track property changes and map annual and post-storm slope failures using sequential air photo imagery. Features mapped from the aerial photos are attributed with information gathered at each site by using a road survey and portable global positioning system (John Montgomery, Assistant Director of Community Development, Laguna Beach 9/13/02).

The method was tested after the 1997-98 El Niño storms when rockfalls and mudslides damaged property in their city. In this case, the area was flown after the damage occurred and photos registered to pre-event orthophoto quads. By comparing the before and after images, they were able to map the extent of damage and examine drainage ways and street crossing for possible flow constrictions. (pers. com. John Montgomery 3/29/02).

Future Availability of Landslide data: The purpose of the city's survey was to examine its potential liability and focused on the quality of the city's street drainage maintenance. It did not include structural damage estimates by the city and no attempt was made to document emergency repair costs. However, this technique has potential applications for estimating widespread landslide damages after extensive storm events by targeting where structural damage should be collected. It would be a powerful tool in association with an electronic permit system that identified landslide-related repair costs.

San Jose

Historic data: The City of San Jose consists mostly of flat topography with hills in the eastern and southern parts of the city. There have been only a few slope failures in the past within the city limits. Currently the City Geologist is the main contact for landslide evaluation. Most of the geologic staff's efforts are in pre-development review of geologic reports and on-site support for grading inspectors during the construction phase.

Future availability of landslide data: The city does not have a method for tracking or estimating annual landslide losses at this time. Response to smaller landslides is on an "as-needed" basis and working files are maintained on individual landslide removal and repair projects. When large landslides occur, the city will usually contract out street repair to an engineering firm with the city staff in a review role. The contract billing data is accessible through the budget office. It will take further analysis to determine how future landslide losses can be collected from the Cities files.

Los Gatos

Historic data: Even though the city has steep hillsides that are prone to landsliding, they have had no significant landslides in recent years. Average home prices in this area range from $250,000 to $1M so slope failures that affect individual lots can be quite costly due to property damage and value of surrounding homes that may be impacted.

Future availability of landslide data: No building permits are issued without approval of the Development Review Committee, unless an emergency condition exits. An ***itemized cost estimate*** must accompany each grading plan for new construction and planned repairs with details on the cost of grading, drainage and erosion control. Landslide repairs that affect structures are contracted out to geotechnical firms because the city lacks the staff expertise to evaluate the scope and method of repair. The repair costs are documented in the contract billing.

Ventura County

Historic data: Ventura county residences suffered the loss of six homes from the La Conchita landslide in 1995 (see photo 1). In this case, part of the landslide stabilization costs ($117,980) is included in the same query that we ran on Public Assistance costs for road repair.

Photo 1: La Conchita Landslide: which buried six homes and destroyed three others on March 4, 1995 in Ventura County.

Future availability of landslide data: Ventura County's Building and Safety department has a digital permit tracking system in place with the ability to assess structural damages using a "code violation" status flag. One of the capabilities they expect from their system is the ability to access structural damage information after a disaster in order to quantify it and apply for financial aid. They

do not currently have an interconnected system that allows access to the Public Works grading information. The County Geologist does not have a system in place for tracking landslide damages on an annual basis.

The City of Los Angeles

Historic data: The City of Los Angeles adopted the nations first grading ordinance in 1952. By the early 1980's the ordinance had become one of the most detailed and strongly enforced in the state (Scullin, 1990). A grading permit is required to import or export earth material from a grading job. Grading permits are triggered whenever a project involves more than 50CY of excavation and is 2 feet vertical deep or the project is within areas designated as "hillside".

Future availability of landslide data: Currently, the city has a plan check & information system (PCIS) in place to track building and grading permits. We have included a copy of the City's building and grading permit as an example of the type of information currently collected (Appendix C). The city collects volume (cubic yardage) estimates on grading and slope repair as part of the grading permit process. The Chief of the Grading Engineering Section suggested that the permit tracking system might need to be modified in order to flag landslide repairs. Presently, landslide damages are not tracked annually.

Permit Process Analysis

California is in the unique position of having a majority of its jurisdictions online. Currently, 318 out of 472 cities and 55 out of the 58 counties have individual web sites. Many of them have their municipal code and building and grading permit forms available on the web. Simple " trade" permits which do not require extensive plan checking are also available for minor mechanical, electrical, re-roofing and plumbing work. The information contained in these permits is rapidly becoming an important and interconnected data source that can be used for collecting landslide loss information over a wide area.

It is legally permissible to post municipal code and information about building and grading permits on the web. In the past few years the concept of e-governments and the number of individual web sites for cities have increased dramatically in California.

In order to track annual landslide losses to residential property, we decided to design a model based on the current data system that is available on building and grading permit forms. Our discussion with the City of Los Angeles grading staff suggests three viable methods that might be employed:

1. Survey the limited pool of contractors that do the bulk of landslide grading repair work after disasters,

2. Track Building Department “inspection requests” or “orders to comply” which initiate site reviews for individual properties and result in estimates of landslide damages, but may not lead to immediate repairs.
3. Try to separate structural damage costs from slope damage costs on building permits where “total valuation of construction” figures are required on building permits.
4. Develop a database query that combines permit information on repair methods, yardage, structural repair costs and construction value in order to estimate total landslide damages.

Suggestion 1 and 2 require the acquisition of new data, something we want to avoid because it would impose additional work on jurisdictions. Suggestions 3 and 4 involve assessment of building permit digital files and possible format modifications to make it workable.

Proposed Model:

We decided to expand upon suggestion 4. The building and grading permits in Appendix B were analyzed from 24 jurisdictions for fee basis, grading permit trigger, construction method and type of data available in digital format. The results of that survey were then used to design a model for tracking landslide damages. The following table is built from those data and could be refined with further review. It shows three categories of common information that is required on most building or grading permits and one category (method of repair) that is not currently required by most permits.

Table 4: LANDSLIDE COST MATRIX

Damage Class (Assign $)	Total Value of Construction (From building permit)	Structural Damage (Construction Costs)	Grading Permit Trigger (Volume CY)	Method of Repair (Optional)
I	< $300	N/A	<100 CY	debris removal
II	$ 300 to $5,000	LOW	100 to 5,000 CY	simple grading
III	>$5,000 and < $30,000	MEDIUM	> 5,000 and < 200,000CY	remove and replace
IV	> $ 30,000	HIGH	> 200,000 CY	engineered structure

The purpose of the matrix is to assign the amount of landslide damage (shown as Damage Class) to a property based on a number of factors selected from the Building permits. We compiled data from multiple fields that are common across different agency databases. In order to compile better estimates of landslide damage, grading costs and structural costs need to be combined. This method of landslide loss tracking would help to account for slope stabilization and emergency grading costs by including the "method of repair". It should be noted that there could be a substantial time lag between emergency repairs and completion of construction on individual houses.

Conclusions

Using the post-disaster FEMA database, we have the data and the ability to query and compile landslide damages in numerous ways using disaster survey reports. The main drawback to these compilations is they are limited mostly to public agency loss estimates.

A brief survey of two of FEMA compilations shows that there is a potential for inadvertently combining residential landslide losses with public agency losses. There is also the potential for mislabeling or failing to label landslide damage to residential property.

A number of Building Departments already make simple "trade" permits available online. Some of the online permit applications contain a required field for cost information. Currently, it is not known how regularly contractors use online permits.

We found two examples in our survey of how permit requirements have been modified and/or standardized in the past. In 1999, Los Angeles, Orange and

Ventura counties passed ordinances to define the specifications of digital data submission for project maps. Recently, Santa Clara, Stanislaus and Alameda counties in cooperation with seven other northern California cities, developed a standardized permit application for use on the web. These regional efforts by local agencies provide a mechanism and forum where databases are discussed and standard forms are developed. Building officials, planners and GIS development staff can use this as an opportunity to design data queries for the information collected on permits to answer future questions on repair costs.

There are a number of fields that building and grading permits already have in common among most agencies:

1. Building permits typically require fees based upon a percentage of the total valuation of repair, remodel or new construction costs.
2. Grading permits normally require an estimate of the volume of material to be moved.
3. On some city forms, there is an option to check what kind of construction will be employed to complete the repair work.

A number of jurisdictions we contacted already have permit systems in place that can separate and track landslides or flag historic slope repairs. The City of Los Angeles has one of the most advanced tracking systems available.

Limits and Opportunities

In California, there is the legal and regulatory framework in place that allows for the collection of landslide data from building and grading permits issued by local land use jurisdictions. With the explosion of e-government databases on the web, landslide information from permits may be available in the near future.

We are interested in running a pilot program to determine if a typical permit system can track annual landslide losses to residential property on a national basis. The simple model developed during this survey may need to be modified before it can be used effectively. We will request the City of Los Angeles or County of Santa Clara this year attempt to use the landslide matrix model and develop a pilot project with them. The purpose is to begin collecting information and possibly modify the landslide cost matrix for future use by other jurisdictions.

In order to develop consistent loss figures, common definitions and categories must be developed among the different agencies collecting landslide damage costs. The California Geological Survey and USGS are currently working on standardized landslide nomenclature that may be of value to local agencies. In the meantime, cities and counties are working together to develop standardized permit requirement forms for web use.

As hard copy paper data is rapidly being converted to digital format by local governments, there is an opportunity to begin tracking structural repair and grading repair costs after future storms. This effort should be coordinated with FEMA after presidential-declared disasters and in conjunction with local jurisdictions, OES and CalTrans.

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APPENDIX A

Summary of California Public Assistance from FEMA for winter storms between 1995 and 1998. This particular database query of public landslide damage also included some damages to private housing. It is not known if queries can be designed that will exclusively limit landslide damage information to residential housing.

Summary of California Public Assistance for Winter Storms between 1995 and 1998			
CA-DSR # 1044	**CA-DSR # 1046**	**CA-DSR # 1203**	**REMARKS**
1/10/95 severe winter storms, flooding and mud/landslide damage	**3/12/95** severe winter storms, winter flooding mud and landslides	**2/9/98** severe winter storms and flooding landslide damage	**Private propery damage recorded in Public Assistance categories**
$2,648,197.00			Includes $117,980 Public Assistance money for La Conchita landslide monitoring: **4.5% adjustment required**
	$2,878,510.00		All reported damages made to local roads and infrastructure: **0% adjustment required**
		$6,965,737.00	Includes $3.32 million for 8 houses in San Leandro, $43,600 for a private house in LA and $44,387 for two houses in Pacifica: **49% adjustment required**

1044	083-69070	4466	SANTA BARBARA, CITY OF	STREET LANDSLIDES (DEOBLIGATION)	ROAD	-$1,930.00
1044	083-91148	94710	CACHUNA OPERATION & MAINTENANCE BOARD	SLIPOUT ON PUBLIC ROAD	STATION 00 AND 00 TO 10 AND 36	$13,100.00
1044	083-91148	94708	CACHUNA OPERATION & MAINTENANCE BOARD	SLIPOUT ON PUBLIC ROAD	SOUTH PORTAL ACCESS ROAD	$540.00
1044	085-00000	17841	SANTA CLARA COUNTY	TREES, TRAILS, PATHS AND LANDSLIDE	ANDERSON LAKE PARK	$1,780.00
1044	087-69112	24187	SANTA CRUZ, CITY OF	REPAIR ROAD SLIPOUT AND RIVER BANK FAILURE	ROAD AND EMBANKMENT AT 3RD STREET AND SAN LORENZO RIVER	$241,942.00
1044	087-69112	16081	SANTA CRUZ, CITY OF	REPAIR ROAD SLIPOUT AND RIVER BANK FAILURE	ROAD AND EMBANKMENT AT 3RD STREET AND SAN LORENZO RIVER	$30,855.00
1044	087-91042	22250	SANTA CRUZ CNTY.PUBL.WKS.DEPT.	EMBANKMENT SLIPOUT AND ROADWAY DAMAGE	OLD SANTA CRUZ HIGHWAY	$25,374.00
1044	087-91042	71685	SANTA CRUZ CNTY.PUBL.WKS.DEPT.	EMBANKMENT SLIPOUT AND ROAD FAILURE	FELTON EMPIRE ROAD	$23,045.00
1044	087-91042	15286	SANTA CRUZ CNTY.PUBL.WKS.DEPT.	EMBANKMENT SLIPOUT & PAVEMENT FAILURE	FELTON EMPIRE ROAD	$3,871.00
1044	087-91042	15300	SANTA CRUZ CNTY.PUBL.WKS.DEPT.	EMBANKMENT SLIPOUT & PAVEMENT FAILURE	HIGHLAND WAY	$17,277.00
1044	087-91042	15292	SANTA CRUZ CNTY.PUBL.WKS.DEPT.	EMBANKMENT SLIPOUT AND PAVEMENT FAILURE	OLD SANTA CRUZ HWY	$27,772.00
1044	087-91042	52151	SANTA CRUZ CNTY.PUBL.WKS.DEPT.	EMBANKMENT SLIPOUT AND PAVEMENT FAILURE	OLD SANTA CRUZ HIGHWAY	$23,690.00
1044	087-91042	19278	SANTA CRUZ CNTY.PUBL.WKS.DEPT.	EMBANKMENT SLIPOUT AND PAVEMENT REPAIR JOB #959556	OLD SANTA CRUZ HIGHWAY	-$4,082.00
1044	089-91001	60738	SHASTA COUNTY DEPARTMENT OF PUBLIC WORKS	REPAIR OF ROAD SURFACE AND SHOULDER WASHOUTS, SLIPOUT	WESTSIDE ROAD - VARIOUS LOCATIONS	$24,974.00
1044	089-91001	60739	SHASTA COUNTY DEPARTMENT OF PUBLIC WORKS	REPAIR OF ROAD SURFACE WASHOUT AND SLIPOUTS	EAST FORK ROAD - VARIOUS LOCATIONS	$5,171.00
1044	089-91001	10216	SHASTA COUNTY DEPT.OF PUBLIC WORKS	REPAIR OF ROAD SURFACE AND SLIPOUT (PARTIAL DEOBLIGATION)	WESTSIDE ROAD - VARIOUS LOCATIONS	-$21,817.00
1044	097-91046	72924	SONOMA CO.,DEPT.OF TRANS.& PUB.WKS(AIRPORT)	EMBANKMENT SLIPOUT AT CREEK	AUSTIN CREEK ROAD	$41,693.00
1044	097-91046	16959	SONOMA CO.,DEPT.OF TRANS.& PUB.WKS(AIRPORT)	LANDSLIDE REPAIR	MONTE VISTA TERRACE	$69,191.00
1044	097-91046	72926	SONOMA CO.,DEPT.OF TRANS.& PUB.WKS(AIRPORT)	EMBANKMENT SLIPOUT	COUNTY ROAD 71010	$39,603.00
1044	097-91046	72925	SONOMA CO.,DEPT.OF TRANS.& PUB.WKS(AIRPORT)	EMBANKMENT SLIPOUT AT CREEK	COUNTY ROAD 7767	$50,690.00
1044	103-91009	20146	TEHAMA COUNTY PUBLIC WORKS DEPARTMENT	EMBANKMENT DAMAGE - SLIPOUT	ROUND VALLEY ROAD	$18,896.00
1044	103-91009	20147	TEHAMA COUNTY PUBLIC WORKS DEPARTMENT	CULVERT WASHOUT AND EMBANKMENT SLIPOUT	MARGUERITE AVE. (HMP)	$2,565.00
1044	103-91009	20144	TEHAMA COUNTY PUBLIC WORKS DEPARTMENT	ROAD EMBANKMENT SLIPOUT AND CULVERT WASHOUT	OSBORN ROAD	$11,927.00
1044	103-91009	16870	TEHAMA COUNTY PUBLIC WORKS DEPARTMENT	SLIPOUT/SLIDE REMOVAL	NEWVILLE ROAD	$3,225.00
1044	105-91021	99021	TRINITY DEPARTMENT OF TRANSPORTATION	REPAIR ROAD SLIPOUT (HMP)	MORGAN HILL ROAD #319	$2,874.00
1044	105-91021	51760	TRINITY DEPARTMENT OF TRANSPORTATION	SLIPOUT ROAD REPAIR	ST. JOHN ROAD #316	$34,451.00
1044	111-91049	93315	VENTURA COUNTY - PWA/TRANSPORTATION DEPARTMENT	LA CONCHITA LANDSLIDE MONITORING	LA CONCHITA ROADWAY	$117,980.00
1044	113-91014	74269	YOLO COUNTY PUBLIC WORKS	LANDSLIDE ACROSS ROADWAY	COUNTY ROAD 40	$13,824.00
1046	000-92003	59507	DEPARTMENT OF FORESTRY	ROAD SLIPOUT AT MILE 5.15	HIHN'S MILL ROAD MILE 5.15	$16,332.00
1046	000-92003	16023	DEPARTMENT OF FORESTRY	ROAD SLIPOUT AT MILE 5.15	HIHN'S MILL ROAD MILE 5.15	$7,146.00
1046	000-92005	75340	DEPARTMENT OF TRANSPORTATION	SHOULDER AND PAVEMENT SLIPOUT	ROUTE 35	$362,054.00
1046	000-92005	74689	DEPARTMENT OF TRANSPORTATION	SHOULDER AND PAVEMENT SLIPOUT	ROUTE 35	$44,010.00
1046	000-92005	16905	DEPARTMENT OF TRANSPORTATION	SHOULDER AND PAVEMENT SLIPOUT	ROUTE 35	-$362,054.00
1046	001-91003	97416	ALAMEDA COUNTY WATER DISTRICT	LANDSLIDE AT WINTER TANK	CUT (EXCAVATION) SLOPE ABOVE TANK	$3,896.00
1046	007-91001	36788	OROVILLE-WYANDOTTE IRRIGATION DISTRICT	SLIPOUTS	SLATE CREEK DIVERSION, ROAD (SITE 3, 3 SLIDES)	$35,557.00
1046	007-91001	36783	OROVILLE-WYANDOTTE IRRIGATION DISTRICT	SLIPOUT	MINERS RANCH CANAL ACCESS RD (SITE 1, 2 SIDES)	$30,920.00
1046	007-91009	36800	PUBLIC WORKS - BUTTE COUNTY	SIDE SLOPE EROSION AND SLIPOUT	BIDWELL AVENUE	$2,946.00
1046	007-91009	36870	PUBLIC WORKS - BUTTE COUNTY	ROADWAY SLIPOUT	PULGA RD	$14,381.00
1046	009-91003	15769	CALAVERAS COUNTY - PUBLIC WORKS	ROAD SLIPOUT	SUMMIT LEVEL ROAD	$38,208.00
1046	013-00000	28467	CONTRA COSTA COUNTY	CREEK BANK EROSION, SLOUGHING, AND SLIPOUT	KELLOGG CREEK	$4,134.00
1046	013-00000	28499	CONTRA COSTA COUNTY	CREEK BANK EROSION AND SLIPOUT	RODEO CREEK - EAST AND WEST BANKS	$3,035.00
1046	013-00000	67715	CONTRA COSTA COUNTY (PUBLIC WORKS DEPT)	DEOBLIGATE (CREEK BANK EROSION AND SLIPOUT)	RODEO CREEK - EAST AND WEST BANKS	-$12,958.00
1046	013-00000	19968	CONTRA COSTA COUNTY (PUBLIC WORKS DEPT)	CREEK BANK EROSION, SLOUGHING AND SLIPOUT	KELLOGG CREEK	$21,778.00
1046	013-00000	19964	CONTRA COSTA COUNTY (PUBLIC WORKS DEPT)	CREEK BANK EROSION AND SLIPOUT	RODEO CREEK - EAST AND WEST BANKS	$9,923.00
1046	013-57764	28438	PLEASANT HILL, CITY OF	LANDSLIDE DEBRIS ON PUBLIC PROPERTY	ALHAMBRA AVENUE SIDEWALK	$16,303.00
1046	013-91049	28471	RECL. DISTRICT #2026, WEBB TRACT	RIPRAP SLIPOUT AT TOP OF OUTSIDE LEVEE BANK	WEBB TRACT LEVEE BANK	$10,850.00
1046	019-00000	72308	FRESNO COUNTY	CLEAR LANDSLIDE DEBRIS	LOS GATOS ROAD	$2,177.00
1046	033-00000	16926	LAKE COUNTY	SLIPOUT (DEOBLIGATION)	COUNTY ROAD 208-B	-$13,727.00
1046	033-00000	72927	LAKE COUNTY	SLIPOUT	COUNTY ROAD 208-B	$13,727.00
1046	037-91012	98167	L.A. CO DEPARTMENT OF PUBLIC WORKS	BIG TUJUNGA LANDSLIDE - REMOVED DEBRIS FROM ROAD	BIG TUJUNGA RPAD	$1,799.00

1046	087-91052 19239	COUNTY SERVICE AREAS	EMBANKMENT SLIPOUT	OLD RANCH ROAD	$47,397.00
1046	087-91052 99126	COUNTY SERVICE AREAS	EMBANKMENT AND SHOULDER SLIPOUT	HOPKINS GULCH ROAD CSA #51	$28,802.00
1046	087-91052 99121	COUNTY SERVICE AREAS	EMBANKMENT SLIPOUT	OLD RANCH ROAD	$3,069.00
1046	087-91052 99139	COUNTY SERVICE AREAS	EMBANKMENT SLIPOUT AND WASHOUT	HIDDEN VALLEY RD. (CSA #26)	$17,936.00
1046	087-91052 99061	COUNTY SERVICE AREAS	SHOULDER EMBANKMENT SLIPOUT	3433 REDWOOD DR MILE 2.2 CSA #33	$26,357.00
1046	087-91052 99164	COUNTY SERVICE AREAS	PAVEMENT AND EMBANKMENT SLIPOUT	0.9 MILE NORTHRIDGE DRIVE, CSA #30	$22,770.00
1046	087-91052 58674	COUNTY SERVICE AREAS	PAVEMENT AND EMBANKMENT SLIPOUT	0.9 MILE NORTHRIDGE DRIVE, CSA #30	$23,845.00
1046	097-33056 72417	HEALDSBURG, CITY OF	LANDSLIDE REPAIR	BURGUNDY ROAD	$52,106.00
1046	097-91046 52135	SONOMA CO DEPT OF TRANS.& PUB.WKS.(AIRPORT)	EMBANKMENT (SHOULDER) SLIPOUT REPAIR (DE-OBLIGATION)	HAITT ROAD, NORTH SHOULDER	-$6,314.00
1046	097-91046 75688	SONOMA CO DEPT OF TRANS.& PUB.WKS.(AIRPORT)	RESTORE ROAD OVER LANDSLIDE	ROAD/SLOPE FAILURE REDWOOD AVE.	$1,790.00
1046	097-91046 74955	SONOMA CO DEPT OF TRANS.& PUB.WKS.(AIRPORT)	ROAD REPAIR FROM LANDSLIDE	VINE STREET	$1,021.00
1046	097-91046 16946	SONOMA CO DEPT OF TRANS.& PUB.WKS.(AIRPORT)	EMBANKMENT (SHOULDER) SLIPOUT REPAIR	HIATT ROAD, NORTH SHOULDER	$6,314.00
1046	103-91009 20610	TEHAMA COUNTY PUBLIC WORKS DEPARTMENT	SHOULDER EROSION/SLIDES/SLIPOUTS	VESTAL ROAD	$8,659.00
1046	103-91009 18969	TEHAMA COUNTY PUBLIC WORKS DEPARTMENT	REPAIR OF ROAD SLIPOUTS AND WASHOUTS	COLYEAR SPRINGS ROAD	$2,896.00
1046	105-91021 18931	TRINITY DEPARTMENT OF TRANSPORTATION	REPAIR ROAD SLIPOUT	ZENIA - LAKE MOUNTAIN ROAD, COUNTY ROAD 503	$113,426.00
1046	105-91021 20589	TRINITY DEPARTMENT OF TRANSPORTATION	SLIPOUT REPAIR	BYOFF ROAD #443	$336.00
1046	105-91021 20590	TRINITY DEPARTMENT OF TRANSPORTATION	SLIPOUT REPAIR	DENNY ROAD #402	$4,408.00
1046	105-91021 20600	TRINITY DEPARTMENT OF TRANSPORTATION	REPAIR ROAD SLIPOUT	ZENIA - BLOCKSBURG RD, #539	$2,593.00
1046	105-91021 20585	TRINITY DEPARTMENT OF TRANSPORTATION	SLIPOUT REPAIR (HMP)	ZENIA LAKE MOUNTAIN ROAD/COUNTY ROAD 503	$8,516.00
1046	105-91021 20592	TRINITY DEPARTMENT OF TRANSPORTATION	SLIPOUT REPAIR	DENNY ROAD #402	$1,618.00
1046	105-91021 20576	TRINITY DEPARTMENT OF TRANSPORTATION	REPAIR ROAD SLIPOUT AND BITMINOUS SURFACE	FELOMILLER ROAD, COUNTY ROAD NUMBER 528	$1,090.00
1046	111-91042 20696	VENTURA COUNTY FLOOD CONTROL DISTRICT	EARTHQUAKE SLIPOUT ON PUBLIC ROAD	ACCESS ROADS - FLOOD CONTROL	$44,272.00
1203	000-91045 27291	MID PENINSULA REGIONAL OPEN SPACE DISTRICT	ROAD / EMBANKMENT SLIPOUTS	VIRGINIA MILL TRAIL	$10,327.00
1203	000-92001 73641	DEPARTMENT OF PARKS AND RECREATION	LANDSLIDE BOULDER DAMAGED PICKUP	VEHICLE VIN: 1GTEK14H5Z561157	$3,947.00
1203	000-92001 73648	DEPARTMENT OF PARKS AND RECREATION	LANDSLIDE DAMAGED DIRT FIRE ROAD	ROADWAY, MESA PEAK ROAD	$6,814.00
1203	000-92001 68882	DEPARTMENT OF PARKS AND RECREATION	LANDSLIDE DAMAGED BEACH ACCESS ROADWAY	ROADWAY	
1203	000-92001 51817	DEPARTMENT OF PARKS AND RECREATION	ROAD SLIPOUT	RIDGECREST ROAD AND 18" CMP	$34,520.00
1203	000-92001 51818	DEPARTMENT OF PARKS AND RECREATION	CULVERT FAILURE AND ROAD SLIPOUT	ROAD TO RESIDENCE #1	$7,448.00
1203	000-92003 74108	DEPARTMENT OF FORESTRY	DEBRIS REMOVAL LANDSLIDE	DEPARTMENT ROADS	$5,250.00
1203	000-92018 2058	DEPARTMENT OF CORRECTIONS	LANDSLIDE ABOVE ROAD	ENTRANCE ROAD, SACRAMENTO STATE PRISON	$100,000.00
1203	001-26000 75201	FREMONT, CITY OF	MISSION PARK LANDSLIDE EMERGENCY PROTECTION MEASURES	IMPROVED RESIDENTIAL PROPERTY	$45,900.00
1203	001-68084 32718	SAN LEANDRO, CITY OF	LANDSLIDE STABILIZATION	HILLSIDE DR, EDGEHILL COURT, AND EIGHT HOUSES	$3,320,000.00
1203	013-02252 7068	ANTIOCH, CITY OF	ROAD SLIPOUT	JAMES DONLON BLVD	$4,143.00
1203	013-54232 958	ORINDA, CITY OF	LANDSLIDE EMERGENCY PROTECTIVE MEASURES	DIABLO VIEW ROAD	$13,772.00
1203	013-60620 5828	RICHMOND, CITY OF	CREEKBANK SLIPOUT	CREEK	$0.00
1203	013-60620 5827	RICHMOND, CITY OF	CREEKBANK SLIPOUT	WILDCAT CREEK	$0.00
1203	013-68378 7594	SAN RAMON, CITY OF	EMERGENCY INSPECTIONS / LANDSLIDES	CITY WIDE	$1,827.00
1203	015-00000 80519	DEL NORTE COUNTY	ROAD SLIPOUT	SOUTH FORK ROAD	$765.00
1203	015-00000 50567	DEL NORTE COUNTY	LANDSLIDE REMOVAL	SOUTH FORK ROAD	$21,223.00
1203	033-00000 1472	LAKE, COUNTY OF	ROAD FAILURE FROM LANDSLIDE	KONOCTI ROAD	$64,514.00
1203	033-91004 1204	CLEARLAKE OAKS COUNTY WATER DISTRICT	WATER AND SEWER LINE DAMAGE BY LANDSLIDE	WATER AND SEWER LINES	$3,594.00
1203	033-91038 51936	LOWER LAKE COUNTY WATER WORKS DISTRICT #1	LANDSLIDE REPAIR	WATER TANK EMBANKMENT	$4,622.00
1203	037-00000 94870	LOS ANGELES, COUNTY OF	REPAIR LANDSLIDE ROAD AND STABILIZE SOIL SLOPES, ROAD REPAIR	CULVERT CROSSING AT DRY CANYON AND COLD CREEK	$0.00
1203	037-00000 6363	LOS ANGELES, COUNTY OF	DEWATERING SYSTEM, LANDSLIDE STABILIZATION	LANDSLIDES	$0.00
1203	037-00000 6354	LOS ANGELES, COUNTY OF	BRIARBLUFF ROAD REPAIR AND LANDSLIDE STABILIZATION	ROAD	$50,870.00
1203	037-44000 95473	LOS ANGELES, CITY OF	REPAIR LANDSLIDE AT TOWER SITE	A HIGH VOLTAGE ELECTRIC TRANSMISSION TOWER	$4,514.00
1203	037-44000 80553	LOS ANGELES, CITY OF	LANDSLIDE INVESTIGATION	HILLSIDE	
1203	037-44000 58591	LOS ANGELES, CITY OF	LANDSLIDE	PRIVATE HOUSING AND PROPERTY	$43,600.00
1203	037-45246 21155	MALIBU, CITY OF	REMOVE LANDSLIDE GENERATED DEBRIS	EMERGENCY SERVICES	$30,000.00
1203	041-00000 75197	MARIN, COUNTY OF	DOWNSLOPE EROSION (SLIPOUT)	BALBOA AVENUE	$50,801.00
1203	041-00000 75188	MARIN, COUNTY OF	SLIPOUT ROAD SHOULDER	FAIRFAX - BOLINAS ROAD	$11,769.00
1203	041-00000 75189	MARIN, COUNTY OF	DOWNSLOPE EROSION (SLIPOUT)	DEBURGH DRIVE	$3,369.00
1203	041-00000 59113	MARIN, COUNTY OF	COUNTY OF MARIN (SLIPOUT)	TENNESSEE VALLEY ROAD	$47,828.00
1203	041-00000 3946	MARIN, COUNTY OF	ROAD SHOULDER FAILURE (SLIPOUT)	FAIRFAX - BOLINAS ROAD	$56,055.00
1203	041-00000 3945	MARIN, COUNTY OF	SLIPOUT / ROAD SHOULDER	FAIRFAX - BOLINAS ROAD	$56,026.00

APPENDIX B

Survey of grading and building permits in selected California communities, indicating the type of digital information currently available through the permit process.

SUMMARY OF FINDINGS: (Current Grading/Building Permits)

Jurisdiction	GradingTrigger	Type of Permit	Digital format	Permit Fee requirement	Remarks
Anaheim	Grading permit req when fill exceeds 100 CY and 3' high, where slopes > 5:1, or in a designated "Hillside Area"	Flatland and Hillside Grading permit	Phase One- permit system went on line in Dec 1999. Municipal code also available on web	A flat rates charged for each type-not based on yardage	12,838 permits issued in 1999. Yardage calculation required
Berkeley		Building permit	Permit services are automated; but plan check is at city counter	Plan check fees based on valuation of project	
Concord		Simple "Trade" permit	On-line, e-forms available for simple permits only		Information available on status of permits
laguna Beach	Material moved > 20CY. All slopes > 2:1-Requires concept review unless it's emergency work	Building and Grading permit	City has computer generated building permits available	Building permit fees based on valuation of project	
Laguna Niguel	Senior CE coordinates plan check in-house or thru private contract eng firm	Building permit	Permits not available on-line		site visits to ensure grading is consistant with plan
Los Angeles City	Grading permit req if >50 CY of excavation, 2ft vertical or in designated "hillside" area	Building and Grading Permits	Plan Check and Information System in place for computer tracking and queries	Fee based on total valuation of work	Has flags for lots w/ previous landslide, grading and special study zones.
Los Angeles County	Grading permit req when fill will support struc, > 50 CY and 3' high, slope exceeds 5:1 or BO determines a hazard exists.	Grading permit & Building Code	Co ordinance 99-0080 defines specs for the digital submission of maps (Orange/Ventura co also have Ord.)	No estimate of project cost required	Permit requires a list of cut and fill volume CY and amount of import & export soil
Los Gatos	Requires approval of a Development Review Committee	Building and Grading permit	A 4% permit tracking fee is charged to upgrade cities computerized tracking system	An itemized cost estimate (including grading, drainage & erosion control costs is required	Plan check fee is a % of grading cost
Malibu	On all slopes > 4:1, in hillside areas.	Building and Grading permit	Copies of permits are available on-line, but an original must be obtained and reviewed at the city counter	Fee based on total valuation of work	
Mission Viejo		Building and Grading permit	Building and grading permits available online	Fee based on total valuation of work	Permit requires the tabulation of excavation, fill and import in (CY)- Confirmed by inspect.

Mountain View		Trade permit	City has e-permits for 10 types of 'trade' building projects but not for grading/bldg		Trade permits include electrical plumbing, re-roof etc
Oakland	Geologic report with analysis of potential dangers.	Trade permit	Permit streamlining in place.	**Building permit requirements were modified for post-fire construction!**	Pre-application meetings available with city staff.
Orange County	Permit req if cut > 50 CY, cut more than 5ft and slope steeper that 1.5:1	Trade Permits and Municipal code	grading permit available		
City of Orange	required for grading > 50 CY, known landslides and slopes 30% and greater,	Grading permit	Hillside development policies in Safety Element of GP		City mostly built-out. Development in the outlying areas.
Rolling Hills	Slope heights < 30 ft at 2:1 slope, > 500 Cy				no export/import from lot grading permited
San Francisco	UBC and local code	Trade permits available on-line	GIS interface to tracking and permits		
San Jose	1997 UBC and Title 24 of CCR apply and the City has local "geologic hazard zone" regulations	Muni code, building, grading and simple permits available online	Their (simple) permit includes a category for "assoc. w/ a damage survey"		41,000 permits/yr and $1.2B construction volume
San Juan Capistrano	Hillside Management regulations. Any development on 10% or greater slope	Grading permit	on-line permit info	Applicant must show percentage of lot graded and volume in (cubic yards)	Grading & Dev Plan fo a Hillside Management Application Code 9-3.505
City of Santa Clara	1997 UBC requirements	Building and Trade Permit	Standardized Permit Application available, future plans for on-line submittal.	Total value of the construction	SMART permit forms developed by Stanislaus & Alameda Co + 7 other local cities
Santa Clara County	2002 UBC and slopes >1.5:1	Building & Grading permits	Simple Permits only	Total size, type and value of the construction	
Sunnyvale	UBC	Building and Trade Permit	e-forms on web site do not include grading/bldg permits. E-History is a planned option!	Total value of the construction	Some trade permits (re-roof) has a mandatory field for $ Value of work
Tustin	2001 CBC and local code	Building and Grading Permit	Minor e-permits available.	Fee schedule established by City Council-not by contract value	
Ventura County	Excavation of >50 CY or 3' high	Building Permit	Some county-wide GIS resources available		

APPENDIX C

The City of Los Angeles' current building and grading permit, shown here as an example of the range of headings that can be designed into a permit form.

B

CITY LA DBS
DEPARTMENT OF BUILDING AND SAFETY
www.ladbs.org
(888) LA4-BUILD (in L.A. County)
(213) 977-6941 (outside L.A. County)

Application for Building Permit or Grading and Certificate of Occupancy

For Office Use Only

Customer Name:	Q-Matic #:
PCIS #: - -	

Project Address	City	Zip	Unit No.
Cross Street:			

Work Description (Briefly describe the scope of work):

Use of Building

Existing Use:

Proposed Use:

Valuation: $

Applicant's Name	Number & Street Name	City & Zip Code	Phone Number

☐ Agent for Owner ☐ Owner ☐ Owner-Builder
☐ Agent for Contractor ☐ Contractor ☐ Architect ☐ Engineer ☐ Developer ☐ Tenant

Property Owner's Name	Number & Street Name	City & Zip Code	Phone Number

Contractor's Name	Number & Street Name	City & Zip Code	Phone Number

City of Los Angeles Business Tax Registration Certification	State License #	Class
Worker's Compensation Carrier	Policy #	Expiration Date

Architect's Name	Number & Street Name	City & Zip Code	Phone Number
State License #:	Expiration Date		

Engineer's Name	Number & Street Name	City & Zip Code	Phone Number
State License #:	Expiration Date		

tenant's Name	Number & Street Name	City & Zip Code	Phone Number

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For Office Use Only

Building Information - Address: **PCIS #:** - -

☐ 1 or 2 Family Dwlg	☐ Apt/Condo/Townhouse	☐ Commercial	☐ EQ (Retrofit Only)	☐ Major Structure
☐ Bldg - **New**	☐ Bldg - **Addition**	☐ Bldg - **Alter/Repair**	☐ Bldg - **Demolition**	
☐ Nonbldg - **New**	☐ Nonbldg - **Addition**	☐ Nonbldg - **Alter/Repair**	☐ Nonbldg - **Demolition**	
☐ Bldg - **Relocation**	☐ **Sign** Permit	☐ **Grading** Permit	☐ Swimming - **Pool/Spa**	

Assesor's Parcel # - -	**District Map #**
Tract	
Block	**Map Ref#**
Lot	**Arb**

Zone	Lot Type	Lot Size	Council District	Census Tr.	Hwy. Ded.	Hillside Grading	Hillside Street	Alley
Building Line	**LADBS Office**	**Fire District**	**Parking District**	**Airport Hazard**	**CZCA**	**Flood Zone**	**High Wind**	**Seismic Study**

Parcel Documents Index

Application Comments

Project Valuation & Fee Information #_____

☐ Express ☐ OTC ☐ APC ☐ Regular P.C. Hours _____

D A C AR X AC RW G SP S

Permit Valuation: $_____

☐ Pre-Inspection ☐ DPI ☐ GPI ☐ SPI $ _____
☐ Hillside Posting $ _____
☐ Other _____ $ _____
☐ Energy Surcharge
☐ Handicap Surcharge
☐ Off-Hour Plan Check
☐ Signature Declaration Attachment

For Cashier's Use Only

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