Chapter Two

Economic and Legal Aspects

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The Economic Importance of Landslides

Costs to the Nation

Reliable estimates as to how much landslides cost the nation are difficult to obtain. It can be stated confidently, however, that the average yearly cost of landslides in the continental United States runs to hundreds of millions of dollars. This money, paid out every year by taxpayers and private companies, includes not only the direct costs of corrections and repairs of damage caused by landslides, but also very large sums for such items as delays of traffic, interruptions of service, and claims for damages (see Fig. 1).

Highways, railroads, and public utilities as a group receive the greatest direct damages; but even here, full costs can be assessed only in individual cases. Heavy losses are also sustained by local governments and homeowners in some cities (see Figs. 2, 3). In parts of the country very severe losses are involved in destruction of farmlands, resorts, and homes, particularly along rivers and lakes where undercutting and slipping occurs (see Fig. 4). The damages in these categories are extremely difficult to evaluate, but they are obviously large. The filling of the reservoir behind the Grand Coulee dam has cost taxpayers and private property owners at least $20,000,000 during the past 20 years in avoidance and correction of damage from landslides (Jones, 1956). A single oil company must have spent well over $1,000,000 in partially controlling slides in the Ventura Avenue oil field, California, to say nothing of its losses in production (Mineral Information Service, 1954).

The nationwide questionnaire yielded data on the typical costs of landslides to highway and railroad organizations. Thus, among the highway departments one state reported annual costs of more than $1,000,000; three, between $500,000 and $1,000,000; one, $250,000 to $500,000; five, $100,000 to $250,000; six, $25,000 to $100,000; and eleven, less than $25,000. These figures apply largely to maintenance costs, because costs of reconstruction and damage claims are not usually accessible. In fact, the figures reported are probably low even for maintenance costs, because many highway department accounting methods are not such as to disclose fully maintenance costs that are directly related to landslide problems.

Railroad accounting procedures, on the other hand, are prescribed by regulation and special projects over and above routine are commonly handled under an authority for expenditure. This results in full application of expenditures to a given project and probably means that the following figures, as far as they go, are somewhat more accurate than those furnished by the highway departments.

Twelve railroads, representing approximately 22 percent of the total roadway mileage in the United States and 30 percent of that in Canada, reported their annual costs. One road showed $500,000 to $1,000,000; two, $250,000 to

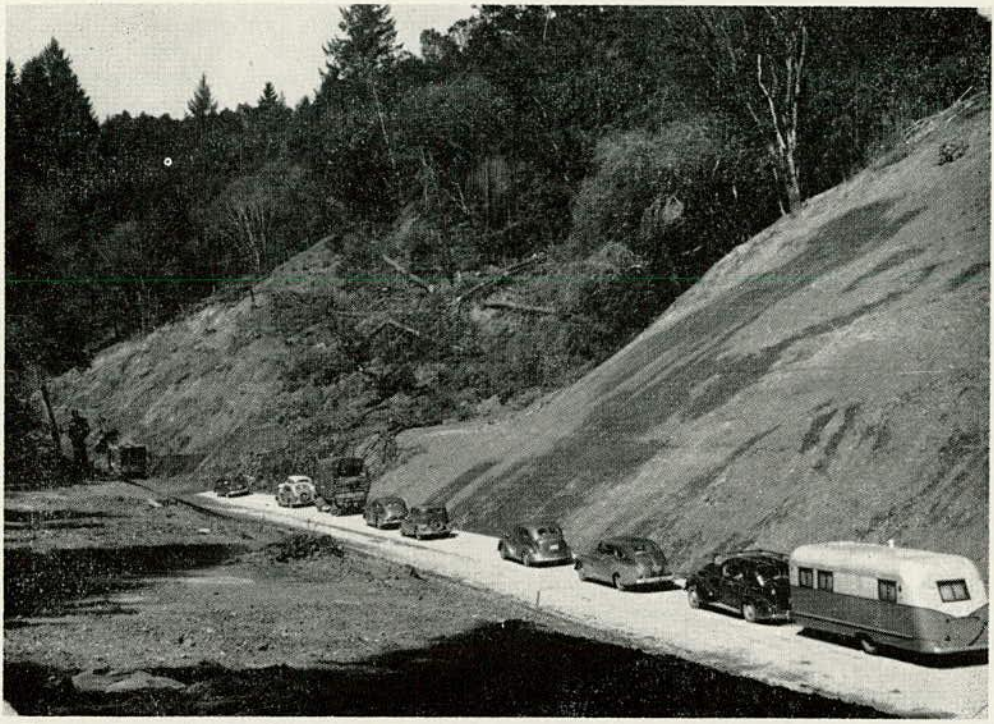

Figure 1. What price landslides? Traffic on Redwood Highway, Calif., obstructed by a relatively small landslide. (Photograph by A. D. Hirsch, courtesy of California Division of Highways)

$500,000; two, $100,000 to $250,000; three, $25,000 to $100,000; and four, less than $25,000. All roads reported certain years with expenditures in considerable excess of these "normal" annual costs. If the railroads that answered the questionnaire can be considered representative from the standpoint of landslide problems, it is easily seen that the direct costs of landslides to the United States and Canadian railroad system amount to well over $5,000,000 per year. Indirect costs, moreover, would far more than double this figure, for none of the costs previously cited include damages to equipment and lading. Between 1949 and 1956, for instance, such costs amounted to more than $1,000,000 on three railroads as a direct result of landslides. One railroad reports that a single slide caused 2,640 train-hours delay. At $20 per hour out-of-pocket labor cost, this item alone amounted to more than $52,000. Delays in lading, increased icing requirements, equipment rental and intangibles must have increased this amount appreciably.

Also not included in the railroad costs listed, but still directly chargeable to a landslide, was the $609,000 reconstruction cost of an irrigation tunnel in Colorado (Fig. 100). Also involved here was the loss of farm production due to lack of water; the same slide cost the railroad almost $93,000 in repairs, plus 960 train-hours delay.

Most highway departments have experienced small landslides for which restoration costs have exceeded $50,000. Many have had other slides whose excess maintenance or correction costs have exceeded $100,000. One slide in a railroad fill required approximately 250,000 cubic yards of earth over a 40-year period to maintain a fill that was originally constructed with 15,000 cubic yards. In another case 1,000,000 cubic

yards were required to restore, temporarily, the damage caused by earth movements during 25 seconds of earth shocks. Damage in the latter case totaled approximately $2,500,000, not including losses from interruption of traffic. Later shocks in 1954 necessitated removal of 200,000 cubic yards of material. Another slide section only 233 feet long showed excess maintenance costs totaling $2,850 per year (Johnston, 1952). Another reported by the same American Railway Engineering Association committee showed excess maintenance at a rate of 5,850 man-hours per mile per year. These figures for "excess" costs represent the difference in maintenance costs before and after successful stabilization by grouting.

The values of many human lives, if they could be assessed, should be added to the figures given at the beginning of the chapter. Loss of life from landslides is small compared to other accidental causes, but it illustrates the importance of thorough investigations of possible landslides. Ladd reports in 1935: "Within the last three years landslides have resulted in more than 3,000 deaths." In 1941 a Pennsylvania rockslide destroyed a bus and killed 22 persons. After long litigations, the damage suits arising from the slide were settled in 1948 at a cost of $500,000. More recently, a rockfall in Virginia resulted in one death and two injuries. A similar occurrence in New York injured 35 people, a slipout under seepage in Maine caused three injuries, and a landslide in Japan caused 67 deaths in addition to great property damage.

Landslide Costs as Related to Types

There are, of course, rather direct relationships between the types and sizes of landslides and the costs of treating them. The various types of landslides are described in Chapter Three and shown on Plate 1. The relations between these types and their economics are discussed in the following in general terms. It must be remembered, however, that few slides fall into simple categories, economically or geologically; rather, most of them present a complex combination of factors and each slide requires individual study.

With some notable exceptions, slides in bedrock are less important economically than are slides in soils (unconsolidated materials). This is largely because rockfalls, block glides, and rockslides tend to occur in mountainous regions where little economic damage results except to railroads, highways and public utilities. Moreover, such slides on transportation routes are generally cleaned up easily, quickly and at relatively low cost. Much the same is true for soil falls and debris slides in unconsolidated materials. Most of the exceptions to these generalizations have to do with the comparatively rare slides that cause serious interruptions to public facilities or that dam or divert watercourses.

The slide types previously mentioned are commonly localized in extent and all of them are characterized by rapid movements. Slumps, on the other hand, may be comparatively large, slow to rapid in movement, and likely to cause greater economic losses than the other types. Some bedrock slumps are related to faults in the rock; considerable damage may often result from them. Many more slumps occur in shales of one kind or another. Shale is mapped as bedrock by the geologist, but many shales have the engineering characteristics of soils, hence landslides in them should be considered with the types that occur in unconsolidated materials.

The other types of slides in soil or unconsolidated material shown on Plate 1 produce, or may produce, great damage and resultant high costs. Failure by lateral spreading, rock fragment flows, loess flows, and earth flows are all rapid movements and have resulted in severe damage and loss of life. Thus, as described more fully in Chapter Three and in the literature cited there, the dikes of Holland have failed by lateral spreading; the catastrophic slide at Elm, Switzerland, by rock fragment flow; that of

Figure 2. Landslides in cities can wipe out property values. This slump-debris flow in Seattle, Wash., began in 1951 and was still moving in 1956. In lake-deposited silts and clays, it was caused primarily by heavy rains, but overloading of a too-steep slope whose toe had been removed by man and nature was a contributing factor. The street in foreground is demolished and the houses useless; total loss of property value is more than $100,000. (Photograph by D. R. Mullineaux, U. S. Geological Survey)

Kansu, China, by loess flow; and the Quebec Province, Canada, slides by mudflows. These types are involved in most of the catastrophic slides and involve great masses of earth, but it is doubtful that the economic cost of these are as great annually as the remaining types which, although much smaller in extent, are many times greater in frequency of occurrence.

The slumps included on Plate 1, are very numerous in soil structures, particularly in highway and railroad fills, levees and dikes. Such slumps often interrupt traffic on the highway or railroad. Their widths are commonly less than 500 feet and often less than 100 feet; the mass involved in a slump movement is usually less than 50,000 cubic yards. Movements are usually at a slow to moderate rate. For example, the Illinois Highway Department lists 59 slides, with 30 involving less than 5,000 cubic yards, 28 involving 5,000 to 50,000 cubic yards, and only one greater than 50,000 cubic yards. It is this type of slide that probably has produced the highest directly assessable damage, as attested by various highway commissions, railroads, and public utilities. This type of slide after maintenance may stabilize itself for a time but, unless weakening factors are corrected or removed, it may redevelop at intervals.

Sand runs, sand and silt flows, and certain debris flows also are usually lim-

ited in extent, but are of frequent occurrence and the damage and loss to farmlands and private property along rivers and lakeshores can be very high. This loss is tied in very closely with the total losses by erosion, so that differentiation into slide loss only is extremely difficult.

In any of the slide groups previously discussed the loss is not necessarily proportional to the volume. A slump involving 10,000 cubic yards on a highway can create losses in interruptions of traffic, through delays and accidents, as great as a slide involving 50,000 cubic yards under similar conditions. Correction or maintenance cost for the latter would, of course, be proportionally greater, but the total costs might well be comparable.

Items in the Cost of Landslides

A number of items comprise the cost of landslides. The chief factors are listed in the following in order of increasing cost, followed by a general discussion of each item. The order of magnitude as given represents the considered opinion of the committee and is not, of course, established by complete cost records.

ESTIMATED AVERAGE COST OF LANDSLIDES

Item	Percent of Total
Engineering	1
Additional right-of-way or property	1
Reconstruction	20
Maintenance	38
Traffic delays, damages and indirect costs	40

This discussion is based on procedures after slides have occurred. Preventive measures can often be the most economical of any action for the correction and elimination of landslides, but it is doubtful that full success will be obtained for reasons brought forth in other parts of this volume.

The greatest cost in the engineering for either prevention or correction of slides is that involved in the subsurface investigation and laboratory testing. Successful treatment is fully dependent on complete information and this information is costly to obtain. For some jobs the engineering costs for investigation and correction may approximate the other costs involved. The books of many organizations, however, do not show breakdowns of engineering costs by individual jobs, so that it is difficult to obtain reliable cost figures for even a few representative jobs. Moreover, a great many small landslides cost little or nothing in the way of engineering beyond the cost of a quick decision in the field as to the repairs needed. For this reason, it is felt that the estimate of one percent of the total direct cost of landslides that is chargeable to engineering is a reasonable one.

Any additional right-of-way necessitated by slide encroachment is expensive. The parcels involved are usually small, but the damage has been done and is evident, hence unit prices are likely to be high. In addition, the possibilities of further damage must be considered. In the case of slope failures, however, the cost of additional land, where available, is often more economical than the measures required for correction or prevention where additional area is not available. In cities, along rivers and lakes, and for other special conditions, acquisition of additional property may not be possible or may be prohibitive in cost. Damage will be higher and corrective measures more costly. The total cost of additional land, estimated at one percent, is minor in the total cost of landslides.

Reconstruction costs constitute an appreciable portion of the total cost of landslides. For the purpose of this chapter reconstruction is defined as the permanent restoration or repair of an installation so as to permit it to serve its original function. The term does not include structures for temporary use during repair. Reconstruction work commonly involves low volume, with proportionately high unit costs. Moreover, reconstruction commonly entails partial

Figure 3. Public and private property destruction on a large scale at Nicolet, Quebec. This slide, a failure by lateral spreading in "sensitive" marine clays, took place without warning on November 6, 1955. It cost a $2,000,000 loss in property and took three lives. The house shown was once at the level of the unbroken ground above it. Except for the greater destruction caused by this one, it is similar to many former slides along much of the St. Lawrence valley. (Photograph by Montreal Gazette)

or complete modification of the original installation, aimed at avoidance of further failures. Such refinements, too, are costly. It is estimated that reconstruction costs will amount to about 20 percent of the total cost of landslides.

Maintenance costs constitute the largest single item for which it is possible to obtain approximate figures. As understood here, maintenance involves either the keeping of the original installation in service by means of routine work and material or the taking of minor corrective measures to improve conditions. It does not include complete reconstruction on the same or new location designed as permanent correction. It is estimated that 38 percent of the total is spent in maintenance. The railroads and highway commissions have many cases on record where $2,000 to $10,000 per year are spent on maintenance of single sections. A few of these are enumerated in the opening paragraphs of this chapter. Average annual railway expenditures for track laying and surfacing (routine labor account) and roadway maintenance accounts have totaled approximately $500 million in recent years. It is estimated that 4 percent of this total is excess maintenance devoted to areas of substandard stability. Many highway commissions have similar records.

If full costs could be assigned to traffic delays, property damage, and indirect effects of landslides, the cost of this item would probably exceed any other single phase of the problem. A wreck of a single train can easily result in damage to lading and equipment of $500,000. Destruction of a single truck with lad-

ing could approach $50,000. Delay of 100 travelers for two hours could be assessed possibly at $500, and some individual travelers count their time as more valuable than this. Delay of a large transport truck can be assessed at a minimum of $14 per hour and train delays can be estimated as entailing $20 per hour direct labor cost. In addition, damages incurred by delay of equipment and lading are appreciable.

One of the largest factors in the total cost of landslides is the destruction of lands and property by slips and slides along watercourses and shores of lakes and oceans. A single slide along Lake Roosevelt in the State of Washington destroyed more than 800 acres (Figs. 31 and 32). Large areas of farmlands have been destroyed by the slides in Quebec and Switzerland that are previously mentioned. Twenty-four houses were removed from a slide area in an Oregon city. A single location along Lake Michigan caused direct monetary damage to a railroad of $250,000, including $118,000 for reconstruction.

No estimate of the yearly loss from such causes is available from the questionnaires, but observations along any watercourse will indicate the seriousness of the damage. As an example, one railroad on a 60-mile section paralleling a river has records on more than 20 slide sections that are affected annually or semiannually by fluctuating river stages. These items and many others make up the item for which the cost is estimated at 40 percent of the total.

Relative Costs of Prevention, Correction and Maintenance

Decisions as between preventive, corrective or maintenance methods call for the utmost judgment of the engineer; at times they call also for diplomatic skill of a high order. A few generalizations are given here; many of the details as to the place of economics in engineering decisions as to choice of method appear in Chapters Seven and Eight.

Preventive measures may be the most economical ones to take in many instances, but no one ever received credit for preventing a slide that never occurred. For this reason, perhaps, it may be difficult for an engineer to convince his superiors that preventive measures are justified, particularly if they involve large expenditures. Where safety of human life is at stake, of course, it is common practice to provide the funds required for adequate protection, regardless of the cost. Thus, rock scaling to eliminate danger of falls is practiced generally by railroads and highways. This is so, even though the cost of rock scaling may be many times that required for cleanup operations if falls were allowed to occur.

The greater the construction cost on new work the more justified are additional expenditures for prevention of slides. This holds particularly true for any installation, such as a dam, where a slide would destroy the usefulness of the structure completely. For many soil structures that are at or near critical heights in fill, however, the failures may occur during construction and can at that time be repaired at reasonable cost without interruption of service. It is not usually economical on such new construction to design slopes to insure stability over the whole project for the worst possible case to be encountered. If embankments are properly designed and constructed, however, embankment failures should be infrequent. This statement applies principally to potential failures in the fills themselves and does not apply generally to foundation failures or combinations; these are separate problems. The fills themselves tend to become stronger with age and service if original construction is adequate.

Much more study of the periodicity of slope failures in various soils and rocks is required before a full analysis of the economics of cut slopes can be made. Generally speaking, and for rock or soil cuts greater than 20 feet in depth, it is usually considered more economical to construct the slopes at angles that will be reasonably safe under most condi-

Figure 4. Shoreline erosion on Lake Michigan, U. S. Highway 12, south of St. Joseph, Mich. Shoreline property is valuable; the soilfalls shown here, caused by toe erosion during high lake levels, destroyed costly homes and threatened a major highway. Temporary (?) correction shown consists of slope-flattening, protective sand blanket on slope, and construction of groins to build up beach sand deposits at toe. (Photograph courtesy of Michigan State Highway Department)

tions rather than to design them with the expectation that no resloping will be required in the future. It must be remembered, too, that some slopes may be stable when constructed but may fail in later years through changes in soil strength.

The generalizations just stated must, of course, be applied with caution to any specific job. If local conditions are such that a cut slope will inevitably cause a slide, the engineer would be foolish indeed to design his slopes for anything less than the worst possible conditions.

Decisions between continued routine maintenance and corrective measures can be made for any installation for which there are good cost records. Briefly, it is believed that continued maintenance is justified if its annual cost is less than 5 percent of the estimated cost of any corrective measures that are expected to last for 20 years or more.

The Law on Landslides

Few legal precedents have been established to guide the courts in determining responsibility for landslides or in assessing the damages caused by them. This dearth of specific laws and legal decisions is perhaps due to two main factors — many, if not most, cases that involve private companies are settled out of court; most cases against State or Federal agencies are settled out of court or the public agency exercises its sovereign right of refusal to consent to be sued.

The following paragraphs summarize the facts on the legal situation as reported in the questionnaire by various state highway organizations and rail-

roads. They are necessarily incomplete and disconnected, but they serve to give some idea of the law and its application in various typical situations. It must be remembered, however, that just as each landslide problem must be considered on its own merits from the engineering standpoint, so must each case concerning damage from landslides be considered on its own legal merits.

RAILROADS

As a matter of general policy, and on the theory that the payment of fees for transportation of goods and persons implies safe transportation, the railroads generally settle claims without recourse to litigation.

STATE HIGHWAYS

Many of the state highway departments reported no special legal problems connected with landslides. Montana and Pennsylvania, however, stated in their questionnaires that they rely on their sovereign rights, which absolve the state of all responsibility unless consent to sue is granted.

West Virginia reports a large number of claims against the highway department for removal of lateral support from private property during construction and for movements of highway embankments that led to encroachment on private property by the embankment toes. Most such claims have been settled without resort to court proceedings.

The North Carolina Highway Department reports that until recently there has been no forum for tort action. In the single case heard since the creation of such a court, it was held that no negligence was attributable to a highway employee.

Claims against it for destruction or damage of private roads, houses and other property, and for blocking of railroads, are reported by the Oregon Highway Department. None of these cases went through litigation; they were settled out of court on the basis of individual situations.

Ohio reports that its chief legal problems have to do with damage to private property that abuts the highways; where there is reasonable evidence that work on the highway has caused damages, the State commonly settles claims out of court. This appears to be the general policy throughout the country.

TOLL ROADS

The legal situation with respect to modern toll roads appears to have been untested up till now. As quasi-governmental organizations, the toll road commissions would appear to fall in the legal category of the state highway departments. Because they charge fees for travel, however, it may be that they will prove subject to the same legal considerations, in part, as are railroads and other private carriers.

WARNING SIGNS

Several state highway organizations report that the state probably has no legal liability in any event for injuries to persons. The posting of warning signs may or may not absolve the state of responsibility, depending in part on local laws but in greater part on the finding of facts in each individual case. Thus, Kentucky reports that warning signs on highways are required when it may be reasonably assumed that the traveling public is confronted with a dangerous situation. Even here, however, the determination of liability depends on the factors in each case. A suit pending in Kentucky at the time this volume was written involved a claim against the highway department for failure to remove a tree from a slipping bank, the tree having fallen on a vehicle. In Ohio there are no specific laws concerning danger warnings, but roadway signs do not necessarily relieve the State of responsibility.

The Illinois Highway Department, on the other hand, reports that the Court

of Claims has held the State free from negligence where adequate warning signs have been placed. No specific law is involved, but signs warning the public of falling rocks would probably relieve the State of liability. Even here it appears that facts and proofs would govern each case in the future. New Hampshire goes even further — its highway department reports that the State is not liable for damages on any state highway; the establishment of warning signs further relieves the State of liability, but apparently such signs are not necessary under the law.

CITIES

Very few data are available as to the law concerning damage to urban property by landslides. In some cases sales of property have been voided by the courts when it was shown that the sale proceedings involved concealment of knowledge of landslide conditions. In Astoria, Ore., and probably elsewhere, certain areas have been withdrawn voluntarily from sale rather than take the risk of later damage claims due to slides.

The City of Los Angeles, Calif., has perhaps had more than its share of landslide problems; out of these troubles has come enlightened legislative action that might well be adopted elsewhere. The following five paragraphs, contributed by John T. McGill of the U. S. Geological Survey, summarize the situation in Los Angeles.

In January 1952 heavy rains resulted in millions of dollars of flood damage to private and public property in hillside areas of Los Angeles. The principal causes of damage were failure and erosion of slopes that had been graded for residential sites and subdivisions during the preceding six years. Because the cut and fill slopes were excessively steep and largely barren, it was not surprising that protective devices, many of which were improperly designed, had either failed completely or proved woefully inadequate.

Before the following winter the City of Los Angeles enacted amendments to the building code providing for the correction of already existing dangerous conditions insofar as practicable and for regulation and control of all new grading in designated hillside areas. Close supervision of new construction unfortunately has left little time for enforcement of the retroactive provisions of the amendments, and it is estimated that there are still about 10,000 hazardous cuts and fills within the city. Control of new grading through a system of mandatory permits, inspections, and certifications has proved very effective, however. The practice of constructing nearly vertical cuts and unusually high fills has been virtually eliminated. The code decrees that slopes of exposed surfaces of cuts and fills shall be no steeper than 1:1 and 1½:1, respectively, although deviations from these standard values are wisely required or permitted as local conditions warrant. Drainage from individual lots must be conducted to streets and away from cut and fill slopes. Erosion protection devices and/or erosion planting must be incorporated in all grading plans before permits will be granted. The City Department of Building and Safety has instigated a policy requiring inspection of sites prior to issuance of building permits in the hillside areas. It has been found in these inspections that on 40 percent of the building sites hazardous conditions already existed or, according to plans submitted, would have been created during construction of the proposed buildings.

For sites located in or adjacent to potential slide areas, building permits are issued only after approval by the Department of a report by a licensed civil or soil engineer giving results of detailed surface and subsurface investigations and recommendations for the design of foundations and control of drainage. The engineer, commonly in collaboration with an engineering geologist, must also locate the border of the area of stability and analyze the effects of possible sliding upon the proposed structure.

The problem of the uncompleted sub-

division has been solved by another recent amendment to the building code requiring that the developer post a bond insuring completion of grading work and pertinent improvements within a reasonable length of time and in accord with approved plans or in a manner that will not constitute a hazard.

In view of the cyclic recurrence in southern California of even greater storms than that of 1952, recommendations were being made in 1955 to the City Council for additional legislation to further eliminate and control hazardous conditions. The major provision of such legislation would authorize preparation by a competent engineering firm of a master plan for safe integrated development of the remaining hillside areas within the city.

Seattle, Wash., is another city that is plagued by landslides. During 1933 and 1934 alone, for instance, a total of 116 claim cases involving landslide damage were filed against the city. The following paragraphs, compiled by D. R. Mullineaux of the U. S. Geological Survey, summarize the legal situation in Seattle.

The city is not responsible for protecting the citizens from a landslide unless the slide is caused by some act of the city. Most suits brought against the city claim that a slide has been caused by street excavation, derangement of drainage, or a broken sewer. The city is responsible for slides due to broken sewers, even if they have been broken by an "act of God", because the sewers were originally put in place by the city.

The city is not responsible for warning citizens about slide areas, or danger from landslides. However, it does attempt to warn persons when they apply for a building permit. The city engineer's office maintains a map showing all recorded slides, and the areas of the slides are marked on the plat sheets held in the office which issues building permits. All building permit requests are checked against these sheets; if the location is in a slide area, the applicant must sign a statement which puts him on record as knowing it is a slide area and agreeing to take precautions. The building code does not prohibit building in a landslide area; the only stipulation is that the footings must reach to "solid ground." A reliable foundation engineer must be retained by the builder to determine what is solid ground.

Responsibility of the Individual

The practice followed by the Los Angeles and Seattle city governments of filing data on landslides and of requiring examinations by engineers calls attention to another problem. This is the question of the legal responsibility of the engineer or geologist who maps or predicts slides, thereby causing lower property values, or the one who has given his professional blessing to an area on which a slide has subsequently developed. Unfortunately, the committee has no direct information as to the legal situation. Judging by the Seattle and Los Angeles building codes previously mentioned, as well as those of some other cities, it appears to be proper for governmental bodies to maintain maps of unstable ground and to make them available for inspection to interested parties. Common sense also would make it appear safe for an individual or an agency to publish such maps if — and only if — it can be shown that the areas mapped as slides are indeed unstable. As a practical matter, however, extreme caution is advised, for "loss of property value" suits may well follow publication of maps or other predictions of future landslides.

Court Decisions

The following summaries of actual court decisions have resulted from a review of law reports. For further information the reader is referred to American Law Reports, Volume 107, pages 591 to 598, and to the American Law Reports Blue Books of supplemental decisions.

Most court cases involve claims for personal property damage or personal injury; no cases were found that concerned damage to land by landslide en-

croachment or by interference with drainage. The question of liability is often a difficult one to determine, because the damage results from the forces of nature. Some of these results are predictable, but more often they are unpredictable, at least in a legal sense. Such so-called "acts of God" generally excuse liability in the absence of proof of negligence in construction or maintenance.

Some railroads, however, have made out-of-court settlements for such "acts of God" as hurricanes, even though no negligence could have been legally ascribed to the carrier. Apparently the whole question of negligence in landslide cases — and even whether a specific landslide is to be considered an "act of God"— is moot in the courts.

Engineering skill and judgment are important factors in many court cases, and perhaps the determining ones in some decisions. Two examples serve to illustrate this point.

In the case of *Boskovich* versus *King County* (Wash.) (188 Wash. 63), it was held that the motorist was not entitled to recover for injuries sustained when a landslide broke loose from a steep hillside bordering the highway and struck the automobile, because there was no proof that negligence in construction or maintenance of the highway was the cause of the landslide.

In an earlier case (*Fisher* vs. *Chesapeake & Ohio Railway,* 104 Va. 635) different reasoning was followed and the railroad was held liable for injuries to one of its own employees. It was reasoned that where ordinary skill would enable engineers to foresee results and guard against them it was the railroad's duty to protect its tracks from landslides. This was based on the premise that cut as well as fill embankment for the roadbed is made by the railroad and not by natural forces; therefore, the railroad is responsible for its care and maintenance and for providing a safe place for its employees to work.

Although reaching different results, these two cases are cited because they point up the necessity for the application of engineering knowledge and skill in construction, careful maintenance, and continuous inspection.

With the exception of the Canadian Pacific Railway, the railroads reported no court actions other than the one previously cited. The following is a resumé of the findings on the Canadian Pacific case, on appeal to the Privy Council in London, as found in the reports of the Judicial Committee of the Privy Council (Law Reports Appeal Cases, 1899).

On appeal from the Supreme Court of British Columbia, the council "held, reversing the judgment of the Court below that in the absence of provisions showing an intention on the part of the Legislature to take away the appellants' right to protect their property from invasion, they were entitled to an injunction to prevent the respondents, users of the water, in disregard of their common law obligation to do no damage to the appellants' land."

This decision was rendered on appeal to the Privy Council from a decree of the Supreme Court of British Columbia October 16, 1897, dismissing an appeal from a decree of Drake, J., January 29, 1897, Supreme Court of British Columbia. The decision continues:

"At trial the judge submitted these two questions to the jury: '(1) Is the water brought by the defendants upon their land for the purpose of irrigation, the sole cause of the damage done to the plaintiff's line of railway by the slide in question? (2) Is the water brought by the defendants on their land for the purpose of irrigation the substantial cause of the damage done to the plaintiff's line of railway by the slide in question?'" The jury answered the first question in the negative and the second in the affirmative.

The trial judge, however, held that: "Irrigating the surface of his land by bringing to and passing upon it foreign water which immediately percolated to the substratum of silt, with which it mingled and then escaped from his land as liquid mud, and seriously damaged the adjoining land, was the necessary

consequence of his exercising his statutory right and did not constitute negligence or afford the owner of the adjoining land any cause for action." This decision was reversed, as previously noted.

SUMMARY

In summary, the committee cannot do better than to quote the following concluding paragraphs from Belser's excellent report (1948):

> It has been said that God gave monkeys tails, but that men had to draw their own conclusions. But one conclusion can be drawn from the state of the law with respect to the financial responsibility of traffic agencies today.
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> What immunity from liability for inadequate traffic-devices and for improper practices traffic agencies possess exists at the sufferance of legislatures. Tort law has developed to the point where the financial responsibility of a public agency can be readily established. Social consciousness has developed to the point that the people are ready to impose liability on their governing bodies.
>
> The courts have long been straining at the bonds of precedent. Dissatisfaction with the restraining doctrines of sovereign immunity and its little half-brother, governmental functions of municipal corporations, has long been expressed by the influential text writers of our time, and by the courts themselves, even when they felt themselves bound to follow precedent on the mandates of higher courts. When those barriers are removed, those traffic agencies who have not mended their ways will be engulfed in a flood tide of pent-up litigation.
>
> Under the impact of the automobile and the increased use of the highways, through which the life-blood of the nation runs, the states have begun to retreat from the bastion of sovereign immunity. The states have been operating highways since 1789, or since they have become states, yet it is only within the last quarter of a century that they began to make themselves liable for defects and negligence. The legislation pertaining to counties and municipalities has had a somewhat longer history, and has gone much further in the same direction.
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> In 1946 the United States Government, the "grandpappy" of them all, passed the Federal Tort Claims Act. "The ancient principle of sovereign immunity from suit, long abandoned by the United States in the field of Contract, has been further undermined by passage of the Federal Tort Claims Act which grants to the Federal courts jurisdiction over actions against the Government for the negligence of its employees. The doctrine of immunity, inherited by this country from eighteenth century English law has been frequently attacked as an anachronism unsuited to democratic society because of the unfairness to individuals with just claims against the government."
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> While it is not believed that the Federal government will find itself involved in many suits for traffic control deficiencies, this recognition of the social undesirability of the doctrine of sovereign immunity passed upon by the greatest law-making body of our time, representative of all the people in the nation, can be nothing if not significant of things to come. Coming events cast their shadows before.
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> The purely verbal distinctions and logical horrors that exist in the extensive ramifications of legal doctrines thriving in the field of municipal liability and parading through the reports under the labels "governmental" and "proprietary" functions have been the subject of much comment. "A relentless barrage of unsympathetic criticism has been directed against the concept upon which the structure of the tort law of municipal corporations has been built. . . . Although critical comment appeared before 1900 widespread interest in the problem among legal commentators seems first to have been stimulated by a notable series of articles by Professor Edwin M. Borchard of the Yale University School of Law. Since that date there have appeared in the law reviews alone over two hundred leading articles and student comment on pertinent judicial decisions."

The trend is to the extension of liability. "The current of criticism has been that it is better that losses due to tort-constituting conduct shall fall upon the municipality rather than on the injured individual; and that the torts of public employees are properly to be regarded, as in other cases of vicarious liability, as a cost of administration of government, which should be distributed by taxes to the government.

"Whether as a result of this criticism or not, there is a noticeable trend in the direction of an extension of municipal tort liability, either by finding that the particular activity is not a 'governmental' one; or by discovering special reasons to take it out of the rule." And again, "The modern tendency is to restrict rather than extend the doctrine of municipal immunity. The courts and law writers are coming more and more to feel the injustice of the entire doctrine. And the tendency of courts, revolted by the hardships resulting from this doctrine in individual cases, is to introduce fictions and artificial distinctions in order to avoid the full rigor of the doctrine."

The revolt of the courts is nowhere better expressed than by Justice McGeehan in *Shaw* v. *City of New York:*

"The courts will be loath to grant immunity to a city that flagrantly flaunts scientific safeguards and experiments with untried devices of untrained, unskilled and unqualified men in this field."

References

Belser, C. H., "The Legal Responsibilities of Traffic Agencies." The Eno Foundation for Highway Traffic Control, Saugatuck, Conn., p. 62-64, 1948.

Johnston, W. T., et al., "Report of Subcommittee on Roadbed Stabilization." *Am. Ry. Eng. Assoc. Proc.*, v. 53, Table 1, p. 742, 1952.

Jones, F. O., et al., "Landslides Along the Columbia River Valley in Northeastern Washington." U. S. Geol. Survey Prof. Paper, in preparation.

Ladd, G. E., "Landslides, Subsidences and Rockfalls as Problems for the Railroad Engineer." *Am. Ry. Eng. Assoc. Proc.*, v. 36, p. 1091-1162, 1935.

Mineral Information Service, "Landslides in Ventura Avenue Oil Field." Mineral Information Service, California Div. of Mines, v. 7, no. 5, p. 1, 1954.