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JOURNAL OF THE BOSTON SOCIETY OF CIVIL ENGINEERS SECTION

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President, Boston Society of Civil Engineers Section, ASCE
1979-1980

New President's Message

I appreciate very much the opportunity to serve as your President. As the oldest engineering society in the United States, we are about to embark on our 131st yearly program. This program will consist both of technical activities and professional activities. At the moment our technical activities appear to be in excellent condition with over 40 meetings and two lecture series scheduled for 1979-1980 by the seven Technical Groups comprising the BSCE Section. Thus, I would like to focus attention in the coming year more on the professional activities aspects of the society.

First of all, I plan to initiate a very strong membership drive during the coming year. At the present time there are over 2,000 members of the BSCE

Section, but there are over 1,000 members of ASCE living in Eastern Massachusetts who are not members of this Section. Our specific recruiting efforts will be directed toward these individuals. I ask each of you to work with me in getting in touch with these individuals (we have the addresses) and inviting them to join in our activities and attend our meetings. I also ask each of you to take the time to sponsor a new member, bring the person to a meeting, and introduce the person to other society members. Through such action each of you can make a contribution to our success.

A second area of proposed activity in the coming year will be in continued strong support of the Design Professionals Joint Government Affairs Council, which is staffed and funded by MSPE, CECNE, BSCES, MSAA, and MALSCE. In the Council, BSCES is represented by two members of our Action Program-Professional Practice Committee. The joint committee's efforts are in monitoring legislation of concern to members of the several societies. The activity will include both the identification of proposed legislation affecting engineers and architects, and influencing the legislation toward a proper course.

A third area of activity will be the strengthening and upgrading of the BSCES Journal. Many of you have received the January issue coincident with the National Convention. This issue shows a new format but we would like to put emphasis in the coming year on a strong, technical content. Accordingly, I have asked Vice President Perkins to supervise this activity for the coming year and have each of the seven technical groups sponsor at least one written paper for the BSCES Journal in their individual programs. And lastly, at the request of many members of BSCES, we will initiate a monthly luncheon series. This program will be chaired by Mr. Brian Hogan, past president of the Massachusetts Section ASCE. These luncheon programs will deal primarily with non-technical matters affecting civil engineers and will afford the opportunity for civil engineers to meet as a group in areas of mutual interest not narrowly limited to their own technical subdiscipline.

These are my thoughts and ideas for the coming year, and I look forward to working with you to achieve these objectives. In particular, if any of you wish to serve on committees, please make yourselves known to me and I will be happy to get you involved in the above-described activities.

William S. Zoino
President 1979-1980

JOURNAL OF THE BOSTON SOCIETY OF CIVIL ENGINEERS SECTION

Presidential Address

AMERICAN SOCIETY OF CIVIL ENGINEERS

MILEPOST FIVE

Presidential Address of Howard Simpson[1]

Introduction

This month marks the completion of the fifth full year of operations since the merger, in April, 1974, of the Boston Society of Civil Engineers and the Massachusettes Section of the American Society of Civil Engineers. The year past, which has been a very busy one indeed for the BSCE Section, has been marked by significant progress and accomplishment; however, there remain several areas requiring continued attention. In these remarks I shall touch briefly on a few highlights of the past year and make recommendations concerning needed improvements in certan areas of the Society's operations.

The ASCE Spring Convention

Certainly the most notable event of this past year was the outstandingly successful national ASCE convention, for which credit is due to the Convention Committee under the chairmanship of Bertram Berger and to the rest of the hundreds of BSCE Section members and national headquarters staff involved in the planning, organizing, and conducting of the convention.

Total registration at the Convention was 3,617; this establishes a new record for a spring meeting, exceeding that of the runner-up (San Francisco, 1973) by more than 83 percent. Other marks set include:

- Second largest registration of any national meeting
- Largest student registration
- Largest total luncheon attendance
- Largest volume of publication sales
- Third highest average technical session attendance
- Second largest registration of spouses at a spring convention
- Sixth largest registration of spouses at any national convention

[1]Presented before Part I of the Annual Meeting of the Boston Society of Civil Engineers Section, ASCE, April 17, 1979

BSCE Section Journal

During the year, the new Publications Committee, under the chairmanship of William Zoino, worked diligently at the task of upgrading the format of the *Journal,* and of compiling a memorable "national convention" edition for free distribution to each Convention registrant. The attractive and interesting issue, dated January 1979, is testimony to the success of the Committee's efforts.

BSCE News

The *News,* replacing the old *Forum,* appears to be performing its function as the Section newsletter quite well, and has been developing a character of its own. Regular features include a discussion of the highlights of the previous month's Board of Government meeting, a message from the President, and advance notice of special meetings, conferences, and workshops. With one exception (the result of a goof by the printer) mailings have been regular and timely.

Technical Groups

As usual, the activities of the Technical Groups, in total, represented our major activity and principal service to the membership. In general, programs were strong and meetings (with the exception of those of one group, which I will touch upon later) quite well attended.

Joint Governmental Affairs Council

Our participation in this activity, together with the CECNE, MSPE, MALSCE, and AIA, has proved to be rewarding. The monthly Government Affairs Bulletin, prepared by the MSPE staff as part of this service, has been keeping the Board of Government abreast of legislative developments of interest to the Society. Of special value has been the opportunity, on several occasions, for BSCE Section representatives to participate in small discussion groups addressed by leading state officials. These latter, incidentally, appear to recognize the importance of the Joint Governmental Affairs group as a vehicle for simultaneous communication with five major engineering and architectural societies, and have been cooperative in making themselves available for these meetings.

Social Events

The new Social Affairs Committee, under the able and resourceful direction of Bob Snowber, planned and conducted two extraordinarily successful affairs, a clambake and a Valentine's Day dance. In contrast to the distressingly poor attendance that was becoming characteristic of our social events in recent years, both events were fully subscribed.

Problem Areas; Recommendations

While the Society overall is in relatively healthy condition, there are several areas where progress has not been entirely satisfactory or which otherwise require additional or special attention during this coming year.

These include:

- Membership
- Lecture Series
- Publications
- Luncheon Meetings
- Implementation of Manual 55
- Computer Technical Group

Membership

In spite of the diligent work of the membership committee, this year has seen another small decline in the number of dues-paying members. It is important to the health of the Society that this trend be arrested and reversed. One promising but largely untapped source for potential new members is new graduates. It is suggested that we institute a program for identifying new graduates settling in this area and for contacting them first by mail and then by telephone or in person. As for other non-members, an effective technique may be to approach one or more key BSCES members in each engineering agency or firm in this area to solicit their assistance in obtaining names of potential members in their organization and in contacting each of them.

Lecture Series

Technical Group Lecture Series are a popular and technically very valuable activity of the Society, and constitute an important source of income to help support our general operations. Due in part to the demands on members' time and energy associated with planning for the ASCE Spring Convention, no lecture series were given this past year. It is hoped that the Lecture Series Committee will take the necessary action to ensure that at least two strong programs are scheduled for the coming year.

Publications

There continues to be a dearth of good quality papers offered for publication in the *Journal.* It is suggested that the Board of Government implement the Budget Committee recommendation that each technical group be requested to provide at least one good quality paper each year.

The BSCES *News* should be expanded to include more news of members and

firms. Readers and organizations should be encouraged to submit appropriate items, and affirmative action should be taken to solicit such material. The editorial board for the *News*, consisting at present of the Secretary as editor, assisted by the Executive Director and Administrative Secretary, should be expanded to provide sufficient personnel to handle this expanded scope.

Luncheon Meetings

There has been discussion of the desirability of scheduling occasional luncheon meetings to address topics of interest to the general membership. It is recommended that such a program be implemented.

Implementation of Manual 55

The Employment Conditions Committee has made a start on this important assignment, but a great amount of work is yet to be accomplished. Appropriate action should be taken to expedite progress on this task.

Computer Technical Group

It has been suggested that it is no longer appropriate or useful to have a separate technical group to deal with this subject, which is an integral part of every engineering discipline. The small meeting attendance that this Group has been experiencing is probably a reflection of the fact that many engineers with special interest in computing may also be concerned with one of the fields covered by our six other Technical Groups. I recommend that the Board of Government evaluate the desirability of terminating the Computer Group.

Conclusion

In closing, I would like to express my heartfelt thanks to the Society officers, to the members of the Board of Government, to all committee chairmen and committee members, and to the many others whose fine work made this another successful year for the Society and whose cooperation and support helped me enormously to carry out my duties as President.

And, especially, I want to thank our Executive Director, Charlotte Dalrymple, and our Administrative Secretary, Susan Albert, for their invaluable guidance and advice and for efficiently carrying out the many tasks in the daily functioning of the Society.

JOURNAL OF THE BOSTON SOCIETY OF CIVIL ENGINEERS SECTION

Professional Papers

AMERICAN SOCIETY OF CIVIL ENGINEERS

BACKGROUND OF THE FREEMAN MEMORIAL LECTURES

By Lee Marc G. Wolman

These lectures commemorating John R. Freeman were begun in 1966. They are one of the many activities of the Boston Society of Civil Engineers Section, ASCE and were stimulated by the inspiration and generosity of Freeman, who was president of both the Boston Society of Civil Engineers and the American Society of Civil Engineers.

Freeman's 1925 bequest to BSCE is administered by the John R. Freeman Fund Committee of the BSCE Section, ASCE. (The members of the committee are Lee Marc G. Wolman, David R. Campbell, Harry L. Kinsel, Lawrence C. Neale and Donald R.F. Harleman.) As sponsor of the lectures, the committee invites authorities in hydraulic engineering to give public lectures on subjects in their special fields.

The first eight lectures were published in the *Journal of the Boston Society of Civil Engineers*, while the ninth — "Heat Disposal in Water Environment" by Donald R.F. Harleman — was published both in the *Journal of the BSCE Section, ASCE*, and in the *Proceedings of ASCE*: Proc. Paper 11585, September, 1975, pp. 1117-1138; and in the *Journal of the Hydraulics Division, ASCE*, Vol. 101, No. HY 9. The introduction to Harleman's lecture documents the earlier lectures and gives hightlights of Freeman's unique professional career. The most comprehensive single record of Freeman's career and influence appears in Hunter Rouse's *Hydraulics in the United States, 1776-1976* (jointly published by the Institute of Hydraulic Research, The University of Iowa, Iowa City, 1976 and the *Journal* of the BSCE Section, ASCE, Vol. 63, 1976). This book earned Rouse the first Freeman Hydraulics Prize awarded by BSCE's John R. Freeman Fund Committee.

Peter S. Eagleson, The Tenth Freeman Memorial Lecturer, is professor of civil engineering at MIT. He has been associated with MIT since 1952. He received the Sc. D. in 1956 and was head of the civil engineering department from 1970 into 1975. His earlier education was at Lehigh University.

Eagleson has pursued a joint career in hydraulics and hydrology. His published work embraces coastal processes and flow induced vibrations, in addition to rainfall and runoff as epitomized in this Freeman Lecture. He performed much of the work covered in the lecture while he was a visiting associate in the Environmental Quality Laboratory at the California Institute of Technology, while on sabbatical leave from MIT.

He has received the Desmond Fitzgerald Medal of BSCE (1959), the Research Prize of ASCE (1963) and the Clemens Herschel Prize of BSCE (1965).

Eagleson is a Fellow of the American Geophysical Union and an active participant in the formulation and evaluation of both national and global hydrological and meteorological sensing and measuring programs.

THE ANNUAL WATER BALANCE

By Peter S. Eagleson,[1] M. ASCE

Preface

The tenth John R. Freeman Memorial Lecture (briefly summarized in this paper) was actually a series of five lectures presented by the writer during the months of April and May, 1977, in the lecture hall of the Center for Advanced Engineering Study at the Massachusetts Institute of Technology.

The central idea of these lectures was the introduction of the method of derived distributions in combining stochastic and deterministic hydrologies into a new approach to analyzing the annual water balance.

Intended to form an instructional introduction to new (and still-developing) ideas, the very large body of material was divided into five topics:

Lecture 1 - April 12 - Introduction to Applied Probability
Lecture 2 - April 19 - Frequency of Annual Precipitation
Lecture 3 - April 26 - Infiltration and Surface Runoff
Lecture 4 - May 3 - Evapotranspiration and Groundwater Runoff
Lecture 5 - May 10 - The Annual Water Balance

and lecture notes were provided [1]. The scope of the lectures was too great to permit even a complete summary here, thus only a discussion of the principle concepts is presented. For more detail, the interested reader is referred to references [2] through [8].

Abstract

A statistical-dynamic formulation of the vertical water budget at a land-atmosphere interface is outlined. Physically-based dynamic and conservation equations express the soil moisture movement processes during rainstorms and interstorm periods in terms of independent variables representing the precipitation, potential evapotranspiration, soil and vegetal properties and water table elevation. Uncertainty is introduced into these equations through the probability density functions of the independent climatic variables, allowing the probability distributions of the dependent water balance elements to be derived. The expected values of these quantities give a long-term average water balance which, *to the first order*, define the annual water yield and water loss in terms of the annual precipitation and potential evapotranspiration, and in terms of physical parameters of the soil, vegetation, climate and water table. This analytical framework provides physical insight into the dynamic coupling of climate-soil-vegetal systems.

[1]Professor of Civil Engineering, Massachusetts Institute of Technology.

Introduction

Growing concern over the possible long-term climatic effects of man's modifications to the land-surface of our planet has prompted increased efforts to improve our understanding of the coupling, across this interface, among physical processes of the atmosphere, soil and vegetation. Past efforts in this direction have been largely of two types:

1. *Empirical studies* which provide validated interrelationships among the principle variables but which, due to their weak physical basis, lack both the generality, and the parametric incorporation of climate, soil and vegetal properties which are necessary for the generation of understanding. Prominent among these works are the early water balance studies of Thornthwaite [9], [10], [11], who used an empirical expression for evapotranspiration in a monthly moisture accounting process based upon a soil's moisture-holding capacity. More recently, Lettau and his co-workers [12], [13] have refined the water balance evapotranspiration term through use of an energy balance but have included no explicit consideration of the soil and vegetal properties which will control the evapotranspiration under most practical circumstances.

2. *Numerical studies* which utilize detailed formulations of the physics at the "micro-process" scale but which, due to their complexity, impose infeasible validation data requirements and impede the generation of overall behavioral insight. Recent examples of such studies are those of Sasamori [14] and of Deardorff [15]. The purpose of these numerical formulations is to simulate the system response to specific climatic inputs, and they usually do so in terms of a large number of climate, soil and vegetal parameters. Both of these characteristics make it difficult to draw generalizations of system behavior.

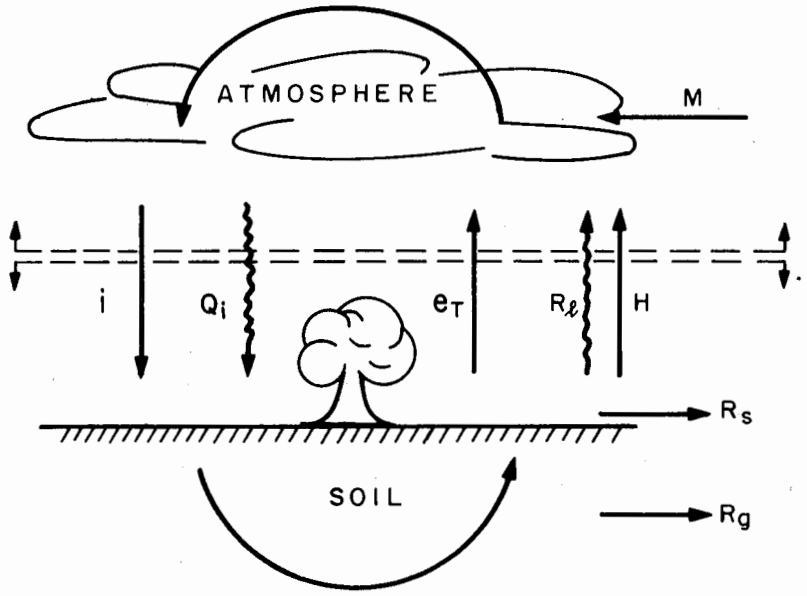
The objective of the present work is to present and discuss a *generalized* water balance model based upon simplified physics of the component processes. The model is detailed enough to capture the *essential* system dynamics yet simple enough to permit analytical (as opposed to numerical) solution. It produces valuable insights into the interactive role of soil moisture in the determination of climate, and provides a tractable basis for deriving generalized probability distributions of such important water balance components as annual basin yield.

Derivation of the water balance equation has been presented elsewhere [2] through [8], and will not be repeated here.

Dynamic Coupling of Atmosphere, Soil and Vegetation

The atmosphere is coupled to the soil-vegetal system through the exchange of momentum, energy, water mass and chemical elements across the land surface. Here we will deal only with energy and water as is indicated schematically in Figure 1. This exchange can be defined by five relationships:

1. *Energy Conservation* — Considering energy fluxes into and out of the soil surface boundary layer we can write the energy equation [16, page 218]:



i = PRECIPITATION
Q_i = INSOLATION
e_T = EVAPOTRANSPIRATION
R_ℓ = LONGWAVE BACK RADIATION
H = SENSIBLE HEAT
M = MOISTURE FLUX
R_s = SURFACE RUNOFF
R_g = GROUNDWATER RUNOFF

Figure 1. Coupled Climate-Soil-Vegetation System

$$\left.\begin{aligned}\rho_s c_g Z_r \frac{\partial T_g}{\partial t} = {} & Q_i(A_s, N) - R_\ell(T_g, N) - \rho_w L_e e_T - H(T_g, T_a) \\ & + q_a - q_p\end{aligned}\right\} \quad (1)$$

in which

ρ_s = mass density of soil-water system, g cm^{-3}
c_g = specific heat of soil-water system, cal g^{-1} °C^{-1}
Z_r = thickness of soil surface boundary layer, cm
T_g = surface temperature, °K
t = time, min

Q_i = net short wave solar radiation, cal $cm^{-2}min^{-1}$
A_S = short wave albedo of surface
N = fractional cloud cover
R_ℓ = net long wave terrestrial radiation, cal cm^{-2} min^{-1}
ρ_W = mass density of evaporated water, g cm^{-3}
L_e = latent heat of vaporization, cal g^{-1}
e_T = actual rate of evapotranspiration, cm min^{-1}
H = net rate of transfer of sensible heat, cal cm^{-2} min^{-1}
q_a = rate of advected energy input, cal cm^{-2} min^{-1}
q_p = rate of use of energy in photosynthesis, cal cm^{-2} min^{-1}

2. *Atmospheric Vapor Transfer Capacity* — The "potential" (i.e., maximum) rate of evaporation is given by the mechanical ability of the atmosphere to transfer vapor away from a surface in the absence of any restriction upon moisture supply to that surface. This may be written [16, pg. 216]:

$$e_p = C\frac{\rho_a|V_a|}{\rho_W P_a}[e_s(T_g) - e_a] \qquad (2)$$

in which

e_p = potential rate of evaporation from the particular surface, cm min^{-1}
C = dimensionless resistance coefficient
V_a = wind velocity at reference elevation, cm min^{-1}
ρ_a = mass density of moist air, g cm^{-3}
$e_s(T_g)$ = saturated atmospheric vapor pressure at ground temperature, dynes cm^{-2}
e_a = atmospheric vapor pressure, dynes cm^{-2}

Realization of this potential depends of course upon an adequate supply of water from the soil and of energy from the sun.

3. *Moisture Transfer in Soil* — The *actual* rate of evapotranspiration from soil moisture is determined by the ability of the soil-vegetal system to deliver water to the surface under the particular atmospheric and soil moisture conditions. Functionally, this is written [5]

$$\left.\begin{aligned} e_T &= e_T(s, t; \text{climate, soil, vegetation}), \quad e_T \leqslant e_p \\ e_T &= e_p, \text{ otherwise} \end{aligned}\right\} \qquad (3)$$

and in which

s = a measure of the soil moisture concentration in surface boundary layer

4. *Water Mass Conservation* — Considering moisture fluxes into and out of the soil surface boundary layer we can write

$$nZ_r \, \partial s/\partial t = i - e_T - y - \dot{S} \tag{4}$$

in which

- n = effective porosity of the soil
- i = precipitation intensity, cm min^{-1}
- y = yield (i.e., surface runoff + groundwater runoff per unit of surface area), cm min^{-1}
- $\dot{S}$ = rate of moisture storage on surface and in saturated zone per unit of surface area, cm min^{-1}

5. *Yield* — The soil moisture movement processes controlling the infiltration of moisture during periods of precipitation, and controlling the net percolation to the zone of saturation will determine the rate of generation of yield. Functionally, this is

$$y = y(s, t; \text{climate, soil}) \tag{5}$$

These five equations define the five land surface variables, T_g, s, y, e_T and e_p in terms of the six climatic variables, e_a, T_a, ρ_a, V_a, N and i and of several land-surface parameters. To consider the true interactive nature of the atmosphere-land surface system as is illustrated in Figure 2, we would add six atmospheric equations (two momentum, two mass conservation, one energy, and one state) as is done in climate-modeling.

Aside from biological growth processes, the atmosphere-soil-vegetal system is dynamic in the sense that the interfacial flux of heat and water is modulated by the presence of resistance and of storage volume. Weather-determined time windows of random length regulate the duration of these fluxes, thus the physical properties of the soil and vegetation determining the flux rates become important. We wish to find a way to incorporate both the process dynamics and the atmospheric statistics into the computation of the long-term water balance because these are the factors which distinguish one climatic region from another.

System Reduction for Water Balance Computation

To isolate the land-surface system, we will omit the energy equation (Eq. (1)) which is the analytical interface through which the atmospheric and land-surface systems are coupled. This changes the role of the land-surface temperature, T_g, from that of a soil state variable to that of an independent "climate" variable. With this modification, the potential rate of evaporation, e_p, becomes an independent climate variable and thus Eq. (2) may be dropped from consideration.

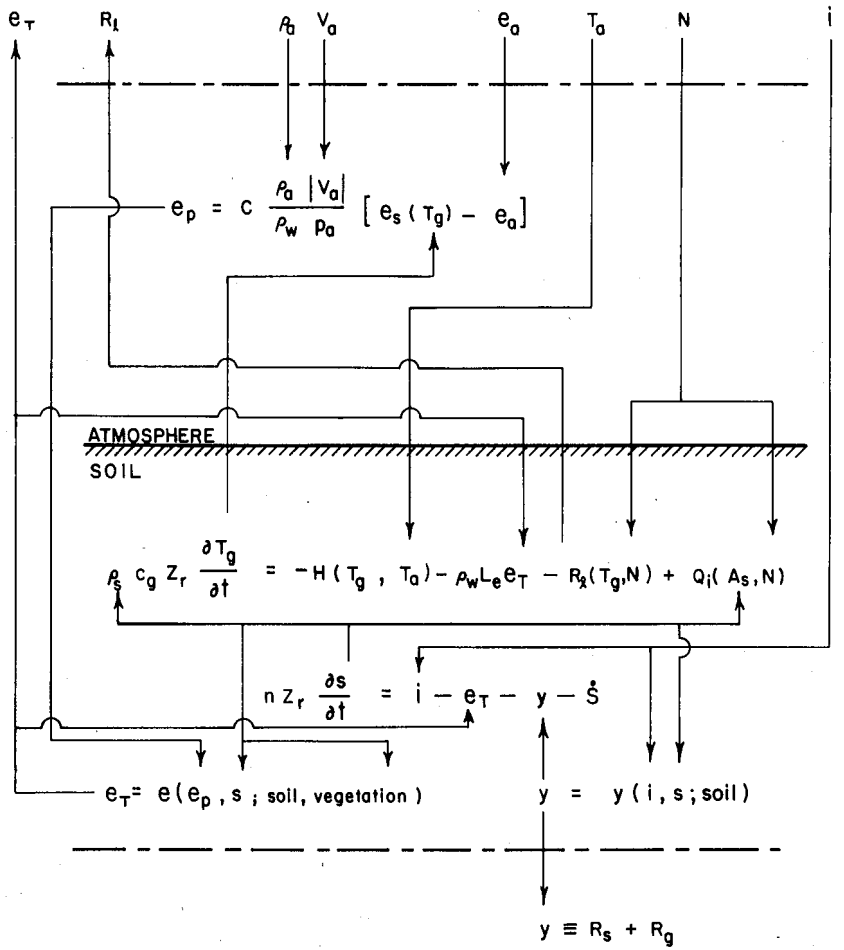


Figure 2. Atmosphere-Land Surface Couplings

The system now reduces to Eqs. (3), (4) and (5) defining s, y and e_T in terms of the climatic variables i and e_p. We can retain the independent climatic variables; T_g, e_a, ρ_a, T_a, V_a and N *implicitly* through use of the modified Penman equation [16, pg. 221] to define e_p.

The Water Balance Equation

Physically-based dynamic equations [17] are used to express the storm infiltration volume, $\forall_i$, and the interstorm evapotranspiration volume, $\forall_e$, in terms of the respective climatic potential rates, i and e_p; the respective

durations of the storm (t_r) and interstorm (t_b) periods; the initial soil moisture, s_o, averaged over the surface boundary layer; and in terms of physical parameters describing the soil and vegetation.

These equations are used along with assumed probability density functions (pdf) for the independent climatic variables to derive the pdf of the dependent flux volumes. Taking the expectation of these last random variables and multiplying by the average number of (independent) events per year gives the long-term average annual infiltration, $E[I_A]$ and the long-term average annual evapotranspiration, $E[E_{T_A}]$.

Gravitational percolation to the water table and capillary rise from the water table to the surface are assumed to be steady and their difference over the year is averaged to give the long-term average ground-water component of yield, $E[R_{g_A}]$.

Assuming as a first approximation that all evapotranspiration comes from soil moisture and considering only systems which are steady-state in the long-term average, the mean annual precipitation, $E[P_A] \equiv m_{P_A}$, is partitioned above the interface according to

$$E[P_A] = E[I_A] + E[R_{s_A}] \tag{6}$$

in which $E[R_{s_A}]$ is the long-term average annual surface water component of yield.

With this result, Eq. (4) can be appropriately time-averaged to give the long-term average soil moisture water balance.

$$E[I_A] = E[E_{T_A}] + E[R_{g_A}] \tag{7}$$

By combination of Eqs. (6) and (7), we have the full water balance equation.

$$E[P_A] = E[E_{T_A}] + E[R_{s_A}] + E[R_{g_A}] \tag{8}$$

By definition, the long-term average annual yield, $E[Y_A]$, is

$$E[Y_A] = E[R_{s_A}] + E[R_{g_A}] \tag{9}$$

Dividing Eq. (7) by the mean annual precipitation and inserting the expectations derived from the physical equations of soil moisture movement, we have the dimensionless average annual water balance equation:

$$\overbrace{[1 - e^{-G-2\sigma}\Gamma(\sigma+1)\sigma^{-\sigma}]}^{\text{Infiltration}} = \overbrace{\frac{E[E_{P_A}]}{m_{P_A}} J(E, M_o, k_v)}^{\text{Evapotranspiration from Soil Moisture}} + \overbrace{\frac{m_r K(1)}{m_{P_A}} s_o^c}^{\text{Groundwater Recharge}} - \overbrace{\frac{Tw}{m_{P_A}}}^{\text{Loss}} \tag{10}$$

Precip. Surface Runoff — Groundwater Runoff

in which

G = gravitational infiltration parameter

$$= \frac{\alpha K(1)}{2}[1 + s_o^c] - \alpha w \tag{11}$$

σ = capillary inflation parameter

$$= \left[\frac{5n\eta^2 K(1)\psi(1)(1 - s_o^2)\phi_i}{6\pi\delta m}\right]^{1/3} \tag{12}$$

$m_{P_A}/E[E_{P_A}]$ = potential humidity

$E[E_{P_A}]$ = long-term average annual potential evapotranspiration

$J(\ )$ = evapotranspiration function

E = evaporation parameter

$$= \frac{2\beta n K(1)\psi(1)\phi_e}{\pi m \bar{e}_p^2} s_o^{d+2} \tag{13}$$

M_O = vegetal canopy density at natural equilibrium
k_V = ratio of potential rates of transpiration and soil surface evaporation
w = apparent velocity of capillary rise from water table [18]

$$= K(1)\left[1 + \frac{3/2}{mc - 1}\right]\left[\frac{\psi(1)}{Z}\right]^{mc} \tag{14}$$

m_τ = long-term average length of rainy season, sec
$K(1)$ = saturated effective hydraulic conductivity, cm sec^{-1}
s_o = long-term average effective soil moisture concentration in the surface boundary layer
c = pore disconnectedness index $= \ell n\,(K(s_o)/K(1))/\ell n\, s_o$
T = one year, sec
α = reciprocal of mean storm intensity $\equiv m_I^{-1}$, sec cm^{-1}
n = effective soil porosity = volume of active voids/total volume
η = reciprocal of mean storm depth $\equiv m_H^{-1}$, cm^{-1}
$\Psi(1)$ = saturated soil moisture potential, cm (suction)

$$= \frac{\sigma_w}{\gamma_w}\left[\frac{n}{k(1)}\right]^{1/2} 10^{-0.33-0.28/m-0.07/m^2}, \text{ [4]}$$

σ_w = surface tension of pore fluid, dynes cm^{-1}
γ_w = specific weight of pore fluid, dynes cm^{-3}
k(1) = saturated effective instrinsic permeability of soil, cm^2 $\equiv K(1)\,\mu_w/\gamma_w$
μ_w = dynamic viscosity of pore fluid, poises
ϕ_i = dimensionless infiltration diffusivity (see Fig. 3)
δ = reciprocal of mean storm duration $\equiv m_{t_r}^{-1}$, $days^{-1}$
m = pore size distribution index = 2/(c - 3), [19]
β = reciprocal of mean interstorm period $\equiv m_{t_b}^{-1}$, $days^{-1}$
ϕ_e = dimensionless exfiltration diffusivity (see Fig. 4)
e_p = potential rate of evaporation from a bare soil surface, cm/sec
d = diffusivity index = (c + 1)/2, [4]

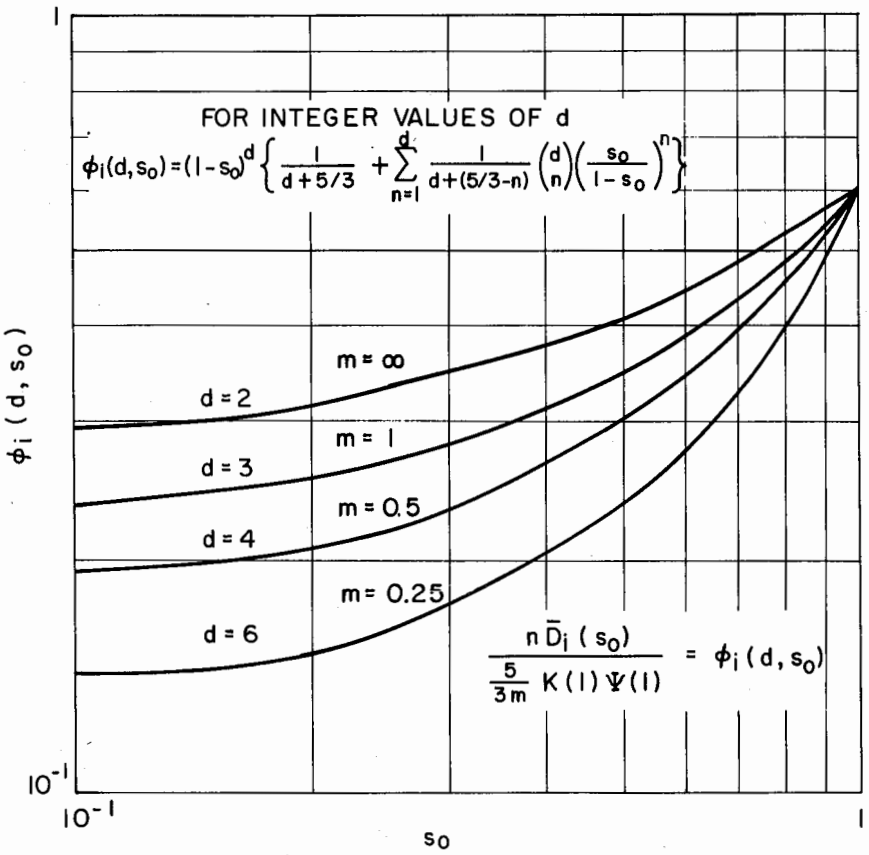


Figure 3. Weighted Mean Diffusion Coefficient-Sorption

For the special case of bare soil, $M_O = k_V \equiv 0$ and $w/\bar{e}_p << 1$, the evaporation function becomes

$$J(E) = \frac{E[E_{T_A}]}{E[E_{P_A}]} = 1 - [1 + 2^{1/2}E]e^{-E} + (2E)^{1/2}\Gamma[\tfrac{3}{2}, E] \qquad (15)$$

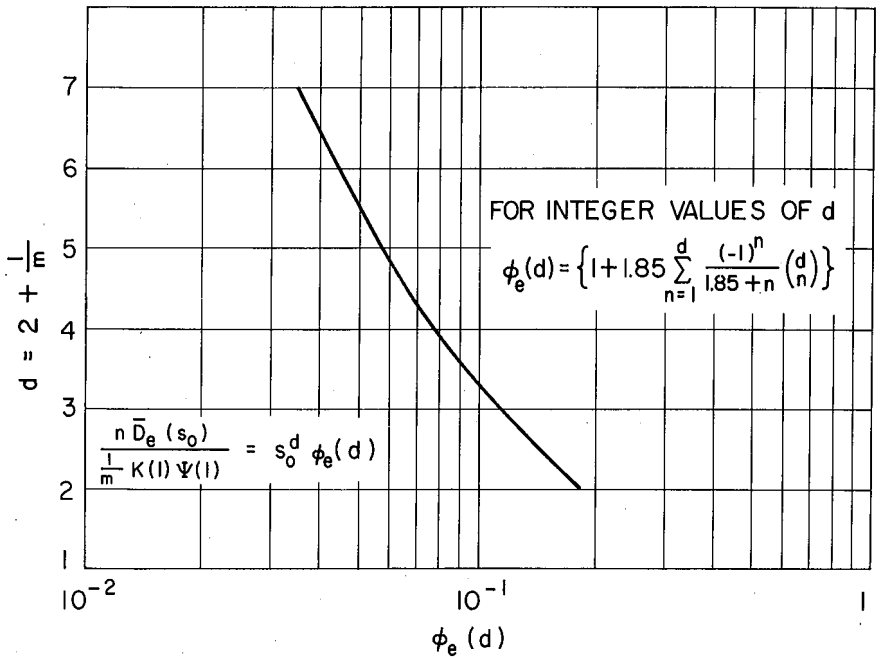


Figure 4. Weighted Mean Diffusion Coefficient-Desorption

This function is plotted in Fig. 5 along with its asymptotes and is the key to understanding water balance behavior in different climates. Looking at Fig. 5 and the definition of E, we see that as the precipitation events occur more frequently (increasing β); as the soil sorptivity increases (increasing ϕ_e); and/or as the potential rate of evaporation decreases (such as in a cold, moist climate), the parameter E increases. These conditions all indicate an increase in the relative evaporation and, as expected, we see the actual average annual evaporation approach the potential in the limit. The actual evaporation is thus controlled primarily by the *climate* for large E, through the potential rate of evaporation, and we describe it as being under *demand control.*

At the other extreme, where there are few rainstorms and the times between them are large; where the soil has low sorptivity and/or the rate of potential evaporation is large, the parameter E decreases. These conditions all indicate a decrease in relative evaporation. Here the actual evaporation is controlled

by the availability of water through insufficient precipitation and/or through inability of the soil to bring moisture to the surface. The evaporation is thus *supply controlled.*

The intersection of the asymptotes of J(E) define

$$E_{critical} = 2/\pi \tag{16}$$

which may be used as a criterion for the classification of climate-bare soil systems as either supply controlled ($E < 2/\pi$) or demand controlled ($E > 2/\pi$) as far as relative evaporation is concerned.

The surface runoff function

$$\frac{E[R_{S_A}]}{E[P_A]} = e^{-G-2\sigma}\Gamma(\sigma+1)\sigma^{-\sigma} \tag{17}$$

is plotted in Figure 6 continuing the assumption that the surface retention is negligible. For small σ, the soil behaves as though wet and the average annual surface runoff approaches $e^{-G}\,E[P_A]$ in the limit. As σ increases, the soil becomes effectively drier and the average annual surface runoff becomes a decreasing fraction of the mean annual precipitation.

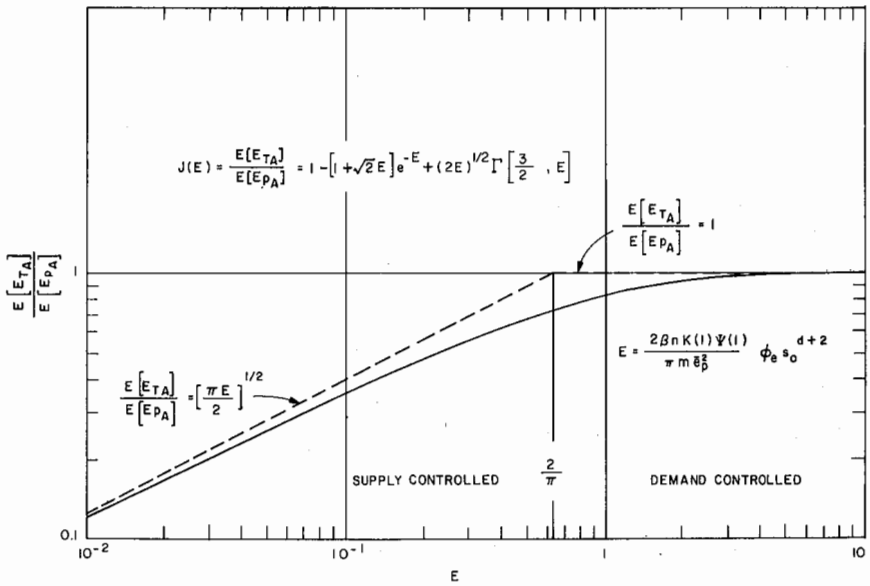


Figure 5. Bare Soil Evaporation Function ($w/\bar{e}_p << 1$)

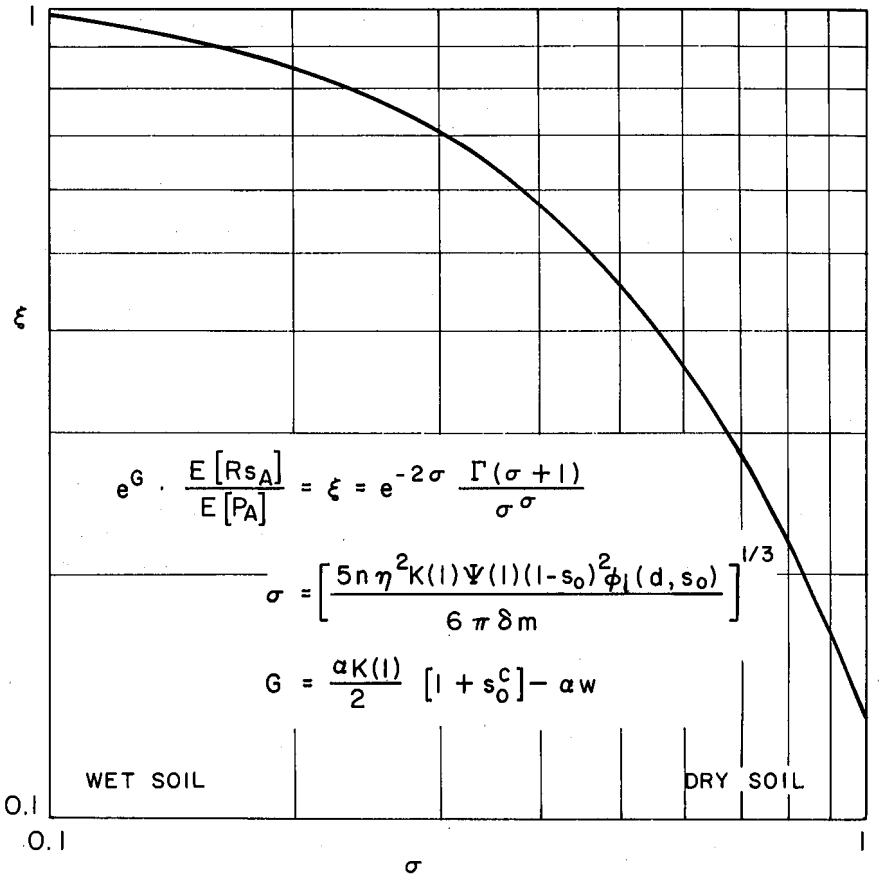


Figure 6. Surface Runoff Function ($h_o = 0$)

From Eqs. (6) and (17), the infiltration function is

$$\frac{E[I_A]}{E[P_A]} = 1 - e^{-G-2\sigma}\Gamma(\sigma + 1)\sigma^{-\sigma} \tag{18}$$

By definition, the groundwater runoff function is

$$\frac{E[R_{g_A}]}{E[P_A]} = \frac{m_\tau K(1)}{m_{P_A}} s_o^c - \frac{Tw}{m_{P_A}} \tag{19}$$

With Eqs. (15) - (19), the average annual water balance can be displayed graphically in a variety of ways. One of these is illustrated in Figure 7. Here the expected value notation has been omitted for convenience, the surface retention capacity, h_o, has been neglected, and the individual water balance components are sketched as a function of average annual precipitation *with everything else held constant.* For very large P_A, of course, E_{p_A} must decline (to zero in the limit) and E_{T_A} with it. The continuously rising groundwater component requires an unlimited lateral transmissivity if we are not to contend with a water table rising to the surface. Both of these very practical limitations are discussed elsewhere [7].

In the lower half of Figure 7, the sketched yield curve displays the commonly-observed linearity in the humid regions where the climatic moisture capacity (i.e., E_{p_A}) controls the losses, while for small P_A, the evaporation is limited by moisture supply.

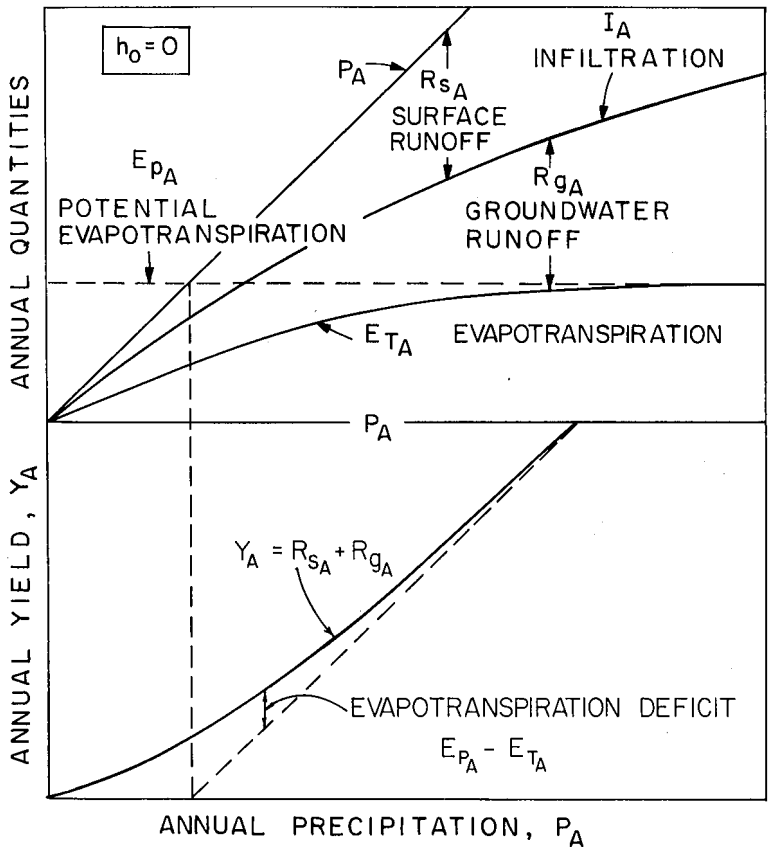
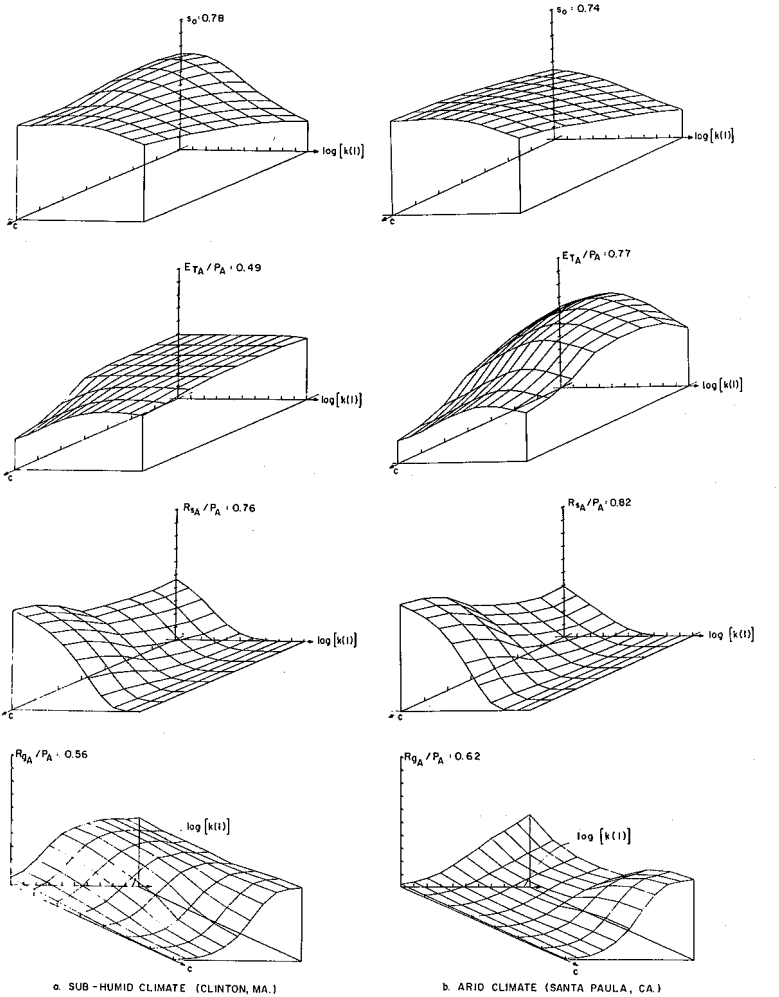


Figure 7. Climate Influence on the Annual Water Balance

Water Balance Sensitivity

Equation (10) and its components as given by Eqs. (15), (17) and (19) may be used to study the sensitivity of the water balance to variations in any of the climate or soil parameters. To illustrate this, Figure 8 is presented in which the average annual soil moisture, evapotranspiration and runoff components are presented as a function of the two primary soil properties, permeability and pore disconnectedness index, under each of two contrasting climates, one sub-humid and the other arid. The climatic properties are summarized in



a. SUB-HUMID CLIMATE (CLINTON, MA.)

b. ARID CLIMATE (SANTA PAULA, CA.)

Figure 8. Sensitivity of Annual Water Budget to Changes in Soil Parameters ($M = 0$, $h_o = 0$, $w/\bar{e}_p << 1$)

Table 1. In each case, the soil permeability was taken as n = 0.35. Once again in this figure, the expectation notation has been omitted and we continue the simplifications, $M = 0$, $h_o = 0$ and $w/\bar{e}_p << 1$). In interpreting the figures, we should remember that as log [k(1)] increases, the soil becomes intrinsically more permeable, while an increase in c indicates a greater pore disconnectedness and a less permeable soil. The numerical value of each ordinate is the maximum plotted value of that variable.

TABLE 1

CLIMATE PARAMETERS FOR SENSITIVITY ANALYSIS

PARAMETER	UNITS	LOCATION	
		Clinton, Ma.	Santa Paula, Ca
m_{P_A}	cm	111.3	54.4
$\bar{e}_p$	cm/day	0.15	0.27
m_{t_b}	days	3.0	10.4
m_{t_r}	days	0.32	1.4
m_τ	days	365	212
$\bar{T}_a$	°C	8.4	13.8
Z	m	∞	∞

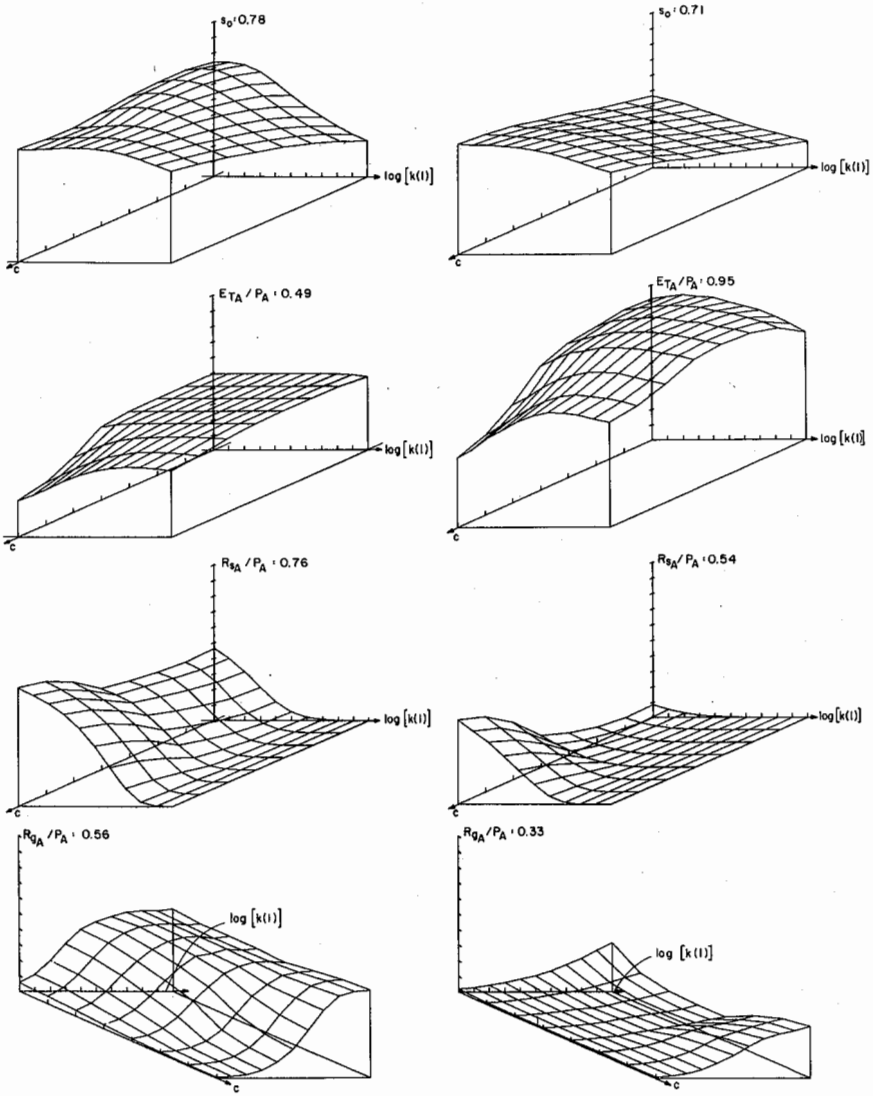
Comparing the two columns of Figure 8, we see contrasting behavior only in evapotranspiration and soil moisture. Beginning with the former, we see insensitivity of E_{T_A} to soil properties in the sub-humid climate except when the soil gets very impermeable. For the arid climate, however, E_{T_A} is sensitive to the soil poperties over their full range. This basic difference in behavior was pointed out earlier in discussion of Figure 5 and it allows us to understand why the soil moisture is highest, in the humid case, where c is small, and in the arid case, where c is large.

In the humid case, the supply of water is adequate and the soil moisture will be largest where the permeability readily admits water (*and* holds it against gravity). This requires a small σ which occurs for small k and large m (i.e., small c).

In the arid case where the evapotranspiration is controlled by the moisture supply to the surface, s_o will be largest where the moisture movement to the surface, as given by E, is smallest. This will occur for small k(1) and large d (i.e., large c).

The runoff behavior is qualitatively the same in both climates. For small k(1), the total yield is predominately surface runoff because the water cannot enter the soil. This component increases with c due to decreasing permeability and it decreases with increasing k(1) due to increasing permeability. The groundwater component also increases with k(1). The "saddle" in the Santa Paula groundwater component with increasing c results from the behavior of the factor $s_o{}^c$ where s_o is less than one and is increasing with c.

A graphic demonstration of the importance of the potential rate of evaporation in determining climate-soil behavior is given in Figure 9. Here we have substituted the Santa Paula, $\bar{\epsilon}_p$, for the Clinton value in the Clinton climate parameter set. The result is to change the Clinton climate from sub-humid to arid wiping out the qualitative difference (just described) between the soil moisture and evapotranspiration sensitivities.



a. CLINTON CLIMATE

b. CLINTON CLIMATE WITH SANTA PAULA P_A

Figure 9. Effect on Annual Budget Due to Decreasing Mean Annual Precipitation

Similarity Parameters

Equation (10) defines the dependent dimensionless variable, s_o, in terms of a set of independent dimensionless variables having physical significance and being the similarity parameters for the average annual water balance. We identify these parameters as follows

$$\text{Potential Humidity} = m_{P_A}/E[E_{P_A}] \quad (20)$$

$$c = \text{Pore Disconnectedness Index} \quad (21)$$

$$G(1) = \alpha K(1) = \text{Gravitational Infiltration Potential} \quad (22)$$

$$\Upsilon = w/K(1) = \text{Index of Water Table Influence} \quad (23)$$

$$2\sigma(0) = \text{Capillary Infiltration Effectiveness} \quad (24)$$

$$2E(1) = \text{Exfiltration Effectiveness} \quad (25)$$

$$\Omega = m_\tau K(1)/m_{P_A} = \text{Groundwater Recharge Potential} \quad (26)$$

$$\Lambda = Tw/m_\tau K(1) = \text{Groundwater Loss Index} \quad (27)$$

The average annual water balance for a climate-bare soil system is thus defined in terms of 8 dimensionless parameters. One is a climate parameter (), one is a soil parameter (c), and the remaining 6 are climate soil parameters.

For the special case of negligible water table influence, two of the climate-soil parameters vanish (Υ and Λ), leaving a total parameter set of 6.

Interestingly, with the incorporation of vegetation (in situations which are in a natural equilibrium state at least) it appears necessary [7] to add only one additional similarity parameter:

$$k_V = \text{Potential Transpiration Efficiency} = \frac{\text{potential rate of transpiration}}{\text{potential rate of evaporation from bare soil surface}} \quad (28)$$

The intersections of the asymptotes of Eq. (15) and of Eq. (18) can be expressed in terms of G(1), $\sigma(0)$, Ω, and E(1). Along with the potential humidity,, these dimensionless intersections provide a rational means of climate classification [7].

First Order Analysis

When we have a function of two random variables

$$Y_A = g_1(P_A) \tag{29}$$

in which $g(P_A)$ is non-linear, we may expand $g(P_A)$ about the mean of P_A (i.e., m_{P_A}) in a Taylor series. Taking the expected value of this expansion term-by-term gives

$$E[Y_A] = g_1(m_{P_A}) + \frac{1}{2}\left[\frac{d^2g}{\partial P_A^2}\bigg|_{m_{P_A}}\right]\sigma_{P_A}^2 + \ldots \tag{30}$$

As long as both $\dfrac{d^2g}{\partial P_A^2}\bigg|_{m_{P_A}}$ and σ_{P_A} are small, we may represent Eq. (30) by the "first order approximation"

$$E[Y_A] = g_1(m_{P_A}) \tag{31}$$

The average annual water balance relation, Eq. (10) can be combined with Eqs. (17) and (19) to eliminate the soil moisture, s_o, from the latter equations. Equation (9) can then be written

$$E[Y_A] = g_2(m_{P_A}, E[E_{P_A}], m_\tau) \tag{32}$$

Assuming that all Y_A variability comes from P_A and none from E_{P_A} and/or τ, we can consider $g_2(m_{P_A})$ to be a first order approximation to $g_1(P_A)$.

We thus drop the expectation symbols in the *average annual* water balance equation to get a first order approximation to the *annual* water balance equation. Using the above notation, this gives, for annual yield, the monotonic function

$$Y_A = g_2(P_A) \tag{33}$$

Given the cumulative distribution function (cdf) of annual precipitation either from observed annual totals or as derived phenomenologically using storm observations [3], we can use Eq. (33) to derive the cdf of annual yield [8]

$$\text{Prob}[Y_A \leq z] = \text{Prob}[P_A \leq g_2^{-1}(z)] \tag{34}$$

This derived yield distribution will be a function of the physical properties of the climate and the soil as well as of the parameters of the precipitation probability distributions. It, therefore, provides a means for quantitatively assessing the effect of land surface change upon the stochastic structure of basin water yield.

The same derived distribution approach is applicable to other elements of the annual water balance.

Summary and Conclusions

The average annual one-dimensional water balance is expressed for natural surfaces in terms of physically-significant dimensionless parameters thereby providing the basis for dynamic similarity of the process and for an improved understanding of climate-soil-vegetation coupling.

A sensitivity analysis points out the critical importance of the potential rate of evaporation in defining water balance variations with other climate and soil parameters.

A first-order analysis of the average annual water balance gives an equation for the annual water balance which can be used to estimate the cumulative distribution functions (cdf) of the components of the annual water balance in terms of the cdf of the annual precipitation and of observable parameters of the physical system. This provides a rational basis for assessing the risk of physical changes to the land surface and for estimating the recurrence interval of such water balance components as basin yield.

Notation

SYMBOL	DEFINITION
A_s	short wave albedo of surface
C	dimensionless resistance coefficient
c	pore disconnectedness index
c_g	specific heat of soil-water system, cal g^{-1} $°C^{-1}$
d	diffusivity index
E	exfiltration parameter
E_{P_A}	annual potential evapotranspiration, cm
E_{T_A}	annual total evapotranspiration, cm
e_a	atmospheric vapor pressure, dynes cm^{-2}
e_p	potential (soil surface) evaporation rate, cm sec^{-1}
$\bar{e}_p$	time average potential evaporation rate, cm sec^{-1}
e_s	saturated atmospheric vapor pressure at ground temperature, dynes cm^{-2}
e_T	actual rate of evapotranspiration, cm min^{-1}
G	gravitational infiltration parameter
H	net rate of transfer of sensible heat, cal cm^{-2} min^{-1}
h_o	surface retention capacity, cm
I_A	annual infiltration, cm
i	precipitation rate, cm sec^{-1}
K(1)	saturated effective hydraulic conductivity, cm sec^{-1}
k(1)	saturated effective intrinsic permeability, cm^2
k_v	potential transpiration efficiency
L_e	latent heat of vaporization, cal g^{-1}
M_o	growth-equilibrium vegetated surface fraction
m	pore size-disconnectedness index
m_{P_A}	average annual precipitation, cm
m_r	mean length of rainy season, days
n	effective medium porosity = volume of active voids/total volume
P_A	annual precipitation, cm

Notation (continued)

SYMBOL	DEFINITION
Q_i	net short wave solar radiation, cal cm^{-2} min^{-1}
q_a	rate of advected energy input, cal cm^{-2} min^{-1}
q_p	rate of use of energy in photosynthesis, cal cm^{-2} min^{-1}
R_{g_A}	annual groundwater runoff, cm
R_ℓ	net long wave terrestrial radiation, cal cm^{-2} min^{-1}
R_{s_A}	annual surface runoff, cm
$\dot{S}$	rate of moisture storage on surface and in saturated zone per unit of surface area, cm min^{-1}
s	effective saturation of medium (i.e., effective soil moisture concentration) = volume of water/volume of active voids
s_o	time and spatial average effective soil moisture concentration in surface "boundary layer"
T	one year, sec
T_a	atmospheric temperature, °C
T_g	surface temperature, °K
t	time, sec
t_a	storm interarrival time, days
t_b	time between storms, days
t_r	storm duration, days
V_a	wind velocity, cm min^{-1}
Ψ_e	interstorm evapotranspiration volume, cm
Ψ_i	storm infiltration volume, cm
w	upward apparent pore fluid velocity representing capillary rise from the water table, cm sec^{-1}
Y_A	annual water yield, cm
y	yield rate, cm sec^{-1}
Z	depth to water table, cm
Z_r	thickness of soil surface boundary layer, cm
z	value of water balance term
α	reciprocal of mean storm intensity, sec cm^{-1}
β	reciprocal of average time between storms, $days^{-1}$
δ	reciprocal of mean storm duration, $days^{-1}$
γ_w	specific weight of pore fluid, dynes cm^{-3}
μ_w	dynamic viscosity of pore fluid, poises
ρ_a	mass density of moist air, g cm^{-3}
ρ_s	mass density of soil-water system, g cm^{-3}
ρ_w	mass density of water, g cm^{-3}
σ	capillary infiltration parameter
σ_w	surface tension of pore fluid, dynes cm^{-1}
η	reciprocal of mean storm depth, cm^{-1}
ϕ_e	dimensionless exfiltration diffusivity
ϕ_i	dimensionless infiltration diffusivity
$\Psi(1)$	saturated soil moisture potential, cm (suction)
E[ ]	expected value of [ ]
g( )	functional notation
J( )	evapotranspiration function
Γ( )	Gamma function

References

1. Eagleson, P.S., "Climate, Soil and the Water Balance — A Framework for Their Analytical Coupling," Lecture Notes for the Tenth John R. Freeman Memorial Lectures, M.I.T., 1977.
2. Eagleson, P.S., "Climate, Soil and Vegetation — 1. Introduction to Water Balance Dynamics," *Water Resources Research*, Vol. 14, No. 5, 1978, pp. 705-712.
3. Eagleson, P.S., "Climate, Soil and Vegetation — 2. The Distribution of Annual Precipitation Derived from Observed Storm Sequences," *Water Resources Research*, Vol. 14, No. 5, 1978, pp. 713-721.
4. Eagleson, P.S., "Climate, Soil and Vegetation — 3. A Simplified Model of Soil Moisture Movement in the Liquid Phase," *Water Resources Research*, Vol. 14, No. 5, 1978, pp. 722-730.
5. Eagleson, P.S., "Climate, Soil and Vegetation — 4. The Expected Value of Annual Evapotranspiration," *Water Resources Research*, Vol. 14, No. 5, 1978, pp. 731-739.
6. Eagleson, P.S., "Climate, Soil and Vegetation — 5. A Derived Distribution of Storm Surface Runoff," *Water Resources Research*, Vol. 14, No. 5, 1978, pp. 741-748.
7. Eagleson, P.S., "Climate, Soil and Vegetation — 6. Dynamics of the Annual Water Balance," *Water Resources Research*, Vol. 14, No. 5, 1978, pp. 749-764.
8. Eagleson, P.S., "Climate, Soil and Vegetation — 7. A Derived Distribution of Annual Water Yield," *Water Resources Research*, Vol. 14, No. 5, 1978, pp. 765-776.
9. Thornthwaite, C.W., "The Climates of North America According to a New Classification," *Geographical Review*, Vol. 21, 1931, pp. 633-655.
10. Thornthwaite, C.W., "Report of the Committee on Transpiration and Evaporation, 1943-44," *Trans. A.G.U.*, 1944, Part V, pp. 686-693.
11. Thornthwaite, C.W., "An Approach Toward a Rational Classification of Climate," *Geographical Review*, Vol. 38, 1948, pp. 55-94.
12. Lettau, H., "Evaporation Climatonomy," *Monthly Weather Review*, Vol. 97, No. 10, Oct. 1969, pp. 691-699.
13. Lettau, H.H. and Baradas, M.W., "Evaporation Climatonomy II," *Monthly Weather Review*, Vol. 101, No. 8, Aug. 1973, pp. 636-649.
14. Sasamori, T., "A Numerical Study of Atmospheric and Soil Boundary Layers," *Journal of the Atmospheric Sciences*, Vol. 27, Nov. 1970, pp. 1122-1137.
15. Deardorff, J.W., "Efficient Prediction of Ground Surface Temperature and Moisture," *Journal of Geophysical Research*, Green Paper 7C0816, 1977.
16. Eagleson, P.S., *Dynamic Hydrology*, McGraw-Hill Book Co., N.Y., 1970.
17. Philip, J.R., "General Method of Exact Solution of the Concentration-Dependent Diffusion Equation," *Australian Journal of Physics*, Vol. 13, No. 1, 1960, pp. 1-12.
18. Gardner, W.R., "Some Steady-State Solutions of the Unsaturated Moisture Flow Equation with Application to Evaporation from a Water Table," *Soil Science*, Vol. 85, No. 4, April 1958, pp. 228-232.
19. Brooks, R.H. and Corey, A.T. "Hydraulic Properties of Porous Media," *Hydrology Paper No. 3*, Colorado State University, Fort Collins, Colorado, March 1964.

JOURNAL OF THE BOSTON SOCIETY OF CIVIL ENGINEERS SECTION

Proceedings

AMERICAN SOCIETY OF CIVIL ENGINEERS

REPORT OF THE BOARD OF GOVERNMENT, 1978-1979

To the Boston Society of Civil Engineers Section,
American Society of Civil Engineers

Pursuant to the requirements of the Bylaws, the Board of Government presents its report of the year ending April 25, 1979.

The following is a statement of membership in the Section:

Honorary Members	5
Assigned ASCE Members	2020
Subscribers:	
Members	1040
Associate Members	433
Affiliate Members	45
Student Chapters	9

Summary of Additions

New Members	26
New Associate Members	78

Summary of Loss of Members

Deaths	7
Resignations	12
Dropped	110

Life Memberships

Life Members	196
Members becoming eligible, April 25, 1979	9

Honorary Membership in the Section

John B. Babcock 3rd.	elected	January 2, 1969
Charles O. Baird, Jr.	elected	January 2, 1969
Arthur Cassagrande	elected	February 1, 1975
Ralph W. Horne	elected	February 1, 1965
John A. Volpe	elected	January 29, 1968

Members lost through death

Harold Bateson	January 1978
Henry Brask	February 1979
Ovidio Chiesa	January 1978
Edouard N. Dube	June 1978
Fritz F. Hampe	July 1978
Joseph A. McCarthy	June 1978
Darrell A. Root	August 1978

MEETINGS OF THE SECTION

September 27, 1978	Joint Meeting with Hydraulics Group
October 25, 1978	Joint Meeting with Geotechnical Group
November 29, 1978	Joint Meeting with Computer Group
December 13, 1978	Joint Meeting with Structural Group
January 24, 1979	Joint Meeting with Transportation Group
February 28, 1979	Joint Meeting with Structural Group
March 14, 1979	Joint Meeting with Construction Group
April 16 and 25, 1979	BSCES Annual Meeting, to be held in two parts: business meeting on April 16, 1979 and awards dinner on April 25, 1979.

For detailed reports of these meetings, refer to Annual Reports of the respective Technical Groups. These were presented at the April 16 meeting of the Section and are published in this issue of the Journal.

*PERMANENT FUND**

The Permanent Fund was established under the Bylaws, Article 10, and is the recipient of all money received as entrance fees. Under certain circumstances income from the Permanent Fund may be transferred to the Current Fund. The Treasurer's report gives details of the year's transactions.

*FUNDS ESTABLISHED BY GIFT OR BEQUEST TO THE BOSTON SOCIETY OF CIVIL ENGINEERS**

JOHN R. FREEMAN FUND. In 1925 the late John R. Freeman, a Past President and Honorary Member of the Boston Society of Civil Engineers, made a gift to the Society of securities which were established as the "John R. Freeman Fund." The income from the Fund is to be particularly devoted to the encouragement of young engineers. Mr. Freeman suggested several uses, such as the payment of expenses for experiments and compilations to be reported before the Society; for underwriting meritorious books or publications pertaining to the hydraulic science or art; or a portion to be devoted to a yearly prize for the most useful paper relating to hydraulics contributed to the Society; or establishing a traveling scholarship every third year open to members of the Society for visiting engineering works, a report of which would be presented to the Society.

EDMUND K. TURNER FUND. In 1916 the Society received a bequest of $1,000 from Edmund K. Turner, a former member, the income of which is to be used for Library purposes.

*Details regarding the value and income of these funds are given in the Treasurer's Report.

ALEXIS H. FRENCH FUND. A bequest of $1,000 was received in 1931 from the late Alexis H. French, a Past President of the Society. The income from the Fund is "to be devoted to the Library of the Society."

CLEMENS HERSCHEL FUND. This Fund was established in 1931 by a bequest of $1,000 from the late Clemens Herschel, a Past President and Honorary Member of BSCE. The income from this fund "is to be used for the presentation of prizes for papers which have been particularly useful and commendable and worthy of grateful acknowledgement."

DESMOND FITZGERALD FUND. The Desmond Fitzgerald Fund, established in 1910 by a bequest of $2,000 from the late Desmond Fitzgerald, a Past President and Honorary Member of BSCE, provided that the income from this Fund "shall be used for charitable and educational purposes." The Board voted on April 13, 1964 to use the income of this Fund to establish a Boston Society of Civil Engineers' Scholarship in Memory of Desmond Fitzgerald, and that it be given to a student in Civil Engineering at Northeastern University.

Subsequent to September 30, 1978, it was voted to accept the recommendation of the Committee at Northeastern University, that the current scholarship award of $200 be given to Carl Dumas. Presentation was made at the 1979 Student Chapter Night meeting of the Society held at Tufts University on March 1, 1979.

HOWE-WALKER FUND. This Fund was created by a vote of the Board of Government and combines the Edward R. Howe Fund and the Frank B. Walker Fund. Income from this joint Fund is used to help defray costs of student awards.

WILLIAM P. MORSE FUND. This Fund, a bequest of $2,000, was received in 1949 from the late William P. Morse, a former member of the Society. No restrictions were placed on the use of this bequest but the recommendation of the Board of Government was "that the Fund be kept intact, and that the income be used for the benefit of the Society and its members." Upon recommendation of the Committee appointed by the President, the Board voted on April 5, 1954 "to appropriate from the income of this Fund a scholarship to be known as the Boston Society of Civil Engineers' Scholarship in memory of William P. Morse, and that it be given to a Civil Engineering student at Tufts University."

Subsequent to September 30, 1978, it was voted to accept the recommendation of the Committee at Tufts University, that the scholarship award of $200 be given to Margot E. Malin. Presentation was made at the 1979 Student Chapter Night meeting of the Society held at Tufts University on March 1, 1979.

RALPH W. HORNE FUND. This Fund, a bequest of $3,000, was received June 29, 1964, from the Directors of Fay, Spofford and Thorndike, Inc., the income from which shall be devoted to a prize or certificate to be awarded annually to a BSCE member designated by the Board of Government to have been outstanding in unpaid public service in municipal, state or federal elective or appointed posts; or in philanthropic activity in the public interest.

THOMAS R. CAMP FUND. This Fund, a bequest of $10,000, was received January 15, 1971, from the Directors of Camp, Dresser & McKee, Inc., to establish the "Thomas R. Camp Fund", the income to be used to support an annual Thomas R. Camp lecture or lectures on outstanding recent developments or proposed or completed research in the sanitary engineering field. The income from the Fund, over and above that needed to support the annual lecture, should be added to the Fund, but could be used otherwise at the discretion of the Board of Government of the Boston Society of Civil Engineers Section of the American Society of Civil Engineers.

LECTURE FUND. The Lecture Fund was established in 1969 for the purpose of providing money for special lectures sponsored by the Society.

KARL R. KENNISON FUND. This Fund comprised two irrevocable trusts established on behalf of the Society by Karl R. Kennison. These trusts consist of shares of the Massachusetts Fund, The Massachusetts Company, Inc., trustees. Since Mr. Kennison's death net income is paid to the Society for a Hydraulics Lecture Fund to be used for various public lectures on this subject, or the Board may withdraw the principal on written demand or make changes in the use of the Fund as it may determine are warranted. The Investment Committee has recommended to the Board of Government that the funds be consolidated with the principal funds in one location.

PRIZES

A number of prizes and awards are recommended for presentation at the Annual Meeting. For the list of awards and recipients, refer to minutes of the Annual Meeting.

COMMITTEES

The usual special committees dealing with the activities and conduct of the Society were appointed. The reports of the committees were presented at that portion of the Annual Meeting held April 16, 1979.

The Board wishes to express its appreciation of the excellent work done by the officers of the Groups and by the Committees of the Section.

For the Board of Government

Howard Simpson, President
Leo F. Peters, Secretary

MINUTES OF THE ANNUAL MEETING OF THE SECTION

PART I

April 17, 1979 — Part I of the 131st Annual Meeting of the Boston Society of Civil Engineers (the fifth meeting of the Boston Society of Civil Engineers Section following the merger of the BSCE with the Massachusetts Section of ASCE) was held at the offices of Camp, Dresser & McKee in Boston. The meeting was called to order at 3:00 p.m. by President Howard Simpson.

Secretary Leo F. Peters summarized the Annual Report of the Board of Government.

In the absence of Treasurer Namyet the written Annual Report of the Treasurer was distributed to those present.

Secretary Peters called for reports from the following Committees and Technical Groups: Action Program-Professional Practice, Advertising, Annual Meeting, ASCE-AGC Liaison, Auditing, Awards, Constitution and Bylaws, Thomas R. Camp Fund, Continuing Education, Disadvantaged Youth, Employment Conditions, John R. Freeman Fund, History and Heritage, Ralph W. Horne Award, Investment, Key Man, Membership, Nominating, Operations Manual, Program, Public Relations, Publications, Social Affairs, Student Chapter, Task Force for 1979 ASCE Convention; also Technical Groups: Computer, Construction, Environmental, Geotechnical, Hydraulics, Structural, Transportation.

Secretary Peters read the reports of those Committee Chairman unable to be present.

Secretary Peters moved that all Committee and Technical Group reports be accepted and placed on file. It was seconded and so VOTED.

President Simpson concluded the meeting's program by presenting his retiring address, which is to be printed in the Journal.

PART II

April 25, 1979 — Part II of the 1979 BSCES Annual Meeting was held at the Parker House Roof in Boston. President Simpson reconvened the meeting at 7:30 p.m. Following the introduction of the head table guests, Pres. Simpson called upon Secretary Peters to assist in the awarding of prizes and certificates of Life Membership, which were in turn presented by the President.

The Ralph W. Horne Award for outstanding community service was presented to Dr. Othar Zaldastani.

Other awards presented were as follows (these were the only awards for technical papers voted this year by the Board of Government):

Clemens Herschel Award
Recipient: David C. Willett
Paper: "The Use of Underground Space"

Geotechnical Group Award
Recipients: Francis C. Pierce and Victor Calabretta
Paper: "Unique Challenges Associated with Marine Structures in New England"

The following persons were awarded Certificates of Appreciation for their services to the Section:

Bertram Berger - Chairman of the 1979 ASCE National Convention Committee
Edward C. Keane - Editor of the BSCES Journal
Saul Namyet - Treasurer
Estelle S. Shuman - for her many contributions of graphic art for Section projects

The Secretary read the names and brief biographies of those who attained ASCE Life Membership this year and President Simpson presented certificates to those present. Recipients were as follows: G. Standish Beebe, Albert A. Goldberg, Alfred Karp, George M. Reece, George E. Rocheford, Benjamin S. Sheinwald, Richard L. Woodward. He also read the names and biographies of those who had attained BSCES Life Membership and President Simpson presented certificates to those present. They were as follows: Richard G. Bergstrom and Fred M. Dodge.

The Secretary also read the names of those members who had died during 1978-79: Harold Bateson, Henry Brask, Ovidio D. Chiesa, Edouard N. Dube, Fritz F. Hampe, Joseph A. McCarthy, Darrell A. Root. A moment of silence was observed.

President Simpson introduced Student Chapter Presidents and their guests.

Teller, Richard J. Scranton, reported the results of the election of Nominating Committee Members. Franklin B. Davis, Richard J. DiBuono and Warren H. Ringer were elected.

President Simpson then presented the gavel to the incoming President, William S. Zoino, who then presented a plaque to retiring President Simpson commemorating his year as president, and briefly outlined his goals for his term in office.

President Zoino then turned the meeting over to the Program Chairman, Frank E. Perkins, who introduced Dick Flavin, reporter-at-large for WBZ-TV. Mr. Flavin's topic was "I don't make jokes. I just watch the Government and report the facts."

One hundred and twelve members and guests attended the dinner and evening meeting.

REPORT OF THE TREASURER

For the Fiscal Year October 1, 1977 to September 30, 1978

FISCAL STANDING

The financial standing of the Section is summarized in the four tables which accompany this report:

Table I - Condensed Statement of Condition
Table II - Condensed Statement of Income and Expenditures
Table III - Detailed Statement of Income and Expenditures
Table IV - Portfolio of Investments and Projected Yield

SECTION INVESTMENTS

The Boston Safe Deposit and Trust Company continues as custodian of our portfolio of securities and has furnished us with an annual summary account. The custodian is authorized to make portfolio changes, and reports quarterly on the portfolio performance. During this year the Invested Income Account which had been maintained separately was merged with the principal account and the custodian was authorized to reinvest investment income.

SECTION BANK DEPOSITS

All non-invested cash is deposited in a Suffolk Franklin NOW Account. The NOW account is an interest bearing checking account. The fiscal year record was:

	Debit	*Credit*	*Balance*
Balance 10/1/77	-	-	$ 10,688.89
Deposits 10/1/77 to 9/30/78	-	$103,032.76	-
Interest	-	1,299.16	-
Checks Drawn	$ 96,090.40	-	-
Totals	$ 96,090.40	$104,331.92	$ 18,930.41

PERMANENT FUND

The Permanent Fund receives its prorated portion of investment income and all entrance fees for the local Section membership. A prorated portion of custodial service charge is debited.

	Debit	*Credit*	*Balance*
Book Value 10/1/77	-	-	$ 85,673.49
Custodian Service	$ 622.53	-	-
Interest, Dividends, Transactions	-	$ 7,381.85	-
Entrance Fees	-	500.00	-
Transfer to Current Fund	-	-	-
Totals	$ 622.53	$ 7,881.35	$ 92,932.81

TECHNICAL GROUP LECTURE SERIES FUNDS 1975-76-77-78

Structural Group-Earthquake Lecture Series (1975-76)

Income	$ 12,459
Expenses	$ 6,544
Surplus	$ 5,915

50% Available for Approved Expenditures	$ 2,957
Expended by Structural Group in 1977-78	990+
Surplus Returned to Current Fund	$ 1,967

Environmental Group-Camp Lecture Series (1975-76)

Income	$ 7,081
Expenses	4,940
Surplus	$ 2,141

50% Available for Approved Expenditures	$ 1,070
Expended by Environmental Group in 1976-77	158
Expended by Environmental Group in 1977-78	173+
Surplus Returned to Current Fund	$ 739

Geotechnical Group-Lateral Earth Pressure Lecture Series (1975-76)

Income	$ 15,387
Expenses	9,435
Surplus	$ 5,952

50% Available for Approved Expenditures	$ 3,159
Expended by Geotechnical Group in 1976-77	1,379
Expended by Geotechnical Group in 1977-78	1,355*
Surplus Returned to Current Fund	$ 425

Geotechnical Group-Deep Foundations Lecture Series (1976-77)

Income	$ 2,254
Expenses	1,888
Surplus	$ 366
50% Available for Approved Expenditures	$ 183

Structural Group-Welding Lecture Series (1977-78)

Income	$ 13,842
Expenses	1,999
Surplus	$ 11,843
50% Available for Approved Expenditures	$ 5,922

Geotechnical Group-Soil Dynamics Lecture Series (1977-78)

Income	$ 16,088
Expenses	13,246
Surplus	$ 2,842
50% Available for Approved Expenditures	$ 1,421

TECHNICAL GROUP FISCAL OPERATIONS 1977-78

	Income	*Expenses*	*Surplus*	*Deficit*
Computer	$ 0	$ 0	$ 0	$ 0
Construction	862	369	493	-
Environmental	286	459	-	173+
Hydraulics	-	115	-	115
Structural	200	1,190	-	990+
Transportation	83	15	68	-
Geotechnical	2,647	4,002	-	1,355*
Total	$4,087	$6,150		

Respectfully submitted,
Saul Namyet, Treasurer

TABLE I

CONDENSED STATEMENT OF CONDITION
Assets, Liabilities and Funds

ASSETS	BOOK VALUE 9-30-78	BOOK VALUE 10-1-77	MARKET VALUE 9-30-78	MARKET VALUE 10-1-77
Suffolk Franklin NOW	$ 18,930.41	$ 10,688.89	$ 18,930.00	$ 10,689.00
Boston Safe Deposit:				
Bonds	92,653.34	67,759.69	81,488.00	59,166.00
Stocks	65,217.30	76,930.11	90,499.00	103,167.00
Cash	61,161.46	49,364.45	61,161.00	49,364.00
Invested Income Cash	10,992.88	14,608.83	10,993.00	14,609.00
Boston Safe Deposit Total	$230,024.98	$208,663.08	$244,141.00	$226,306.00
Total Assets	$248,955.39	$219,351.97	$263,071.00	$236,995.00
LIABILITIES AND FUNDS				
Permanent Fund	$ 92,932.81	$ 85,673.49	$ 98,635.84	$ 92,918.00
Freeman Fund	72,336.94	67,047.17	76,776.06	72,716.00
Turner Fund	4,055.24	3,758.69	4,304.10	4,076.00
Fitzgerald Fund	6,516.95	6,225.76	6,916.88	6,752.00
French Fund	4,011.01	3,717.69	4,257.16	4,032.00
Herschel Fund	2,590.73	2,401.28	2,749.72	2,604.00
Howe Fund	4,407.16	4,107.86	4,677.62	4,455.00
Morse Fund	6,010.20	5,756.07	6,379.03	6,243.00
Walker Fund	1,975.89	1,854.38	2,097.15	2,011.00
Horne Fund	5,735.77	5,501.71	6,087.76	5,967.00
Lectures Fund	6,169.69	6,169.69	6,548.31	6,691.00
Camp Fund	14,635.87	13,565.59	15,534.02	14,713.00
Brackett Fund	300.00	-	318.41	-
Kennison Fund	4,899.16	-	5,199.81	-
Invested Current Fund	3,447.56	2,883.70	3,659.13	3,128.00
Total Invested Funds	$230,024.98	$208,663.08	$244,141.00	$226,306.00
Continuing Education Fund	$ 5,156.33	$ 3,866.84	$ 5,156.00	$ 3,867.00
Boring Data Fund	1,595.81	1,595.81	1,596.00	1,596.00
Student Loan Fund	1,414.24	1,404.24	1,414.00	1,404.00
Current Fund	0	0	0	0
Group Lectures	9,759.32	12,776.38	9,759.00	12,776.00
Corpus	(3,675.61)	(8,954.38)	(3,675.00)	(8,954.00)
Uninvested Kennison Fund	4,680.32	0	4,680.00	0
Total Liabilities	$ 18,930.41	$ 10,688.89	$ 18,930.00	$ 10,689.00
Total Liabilities and Funds	$248,955.39	$219,351.97	$263,071.00	$236,995.00

TABLE II — CONDENSED STATEMENT OF INCOME AND EXPENDITURES — DISTRIBUTION OF INVESTED FUNDS

Fiscal Year October 1, 1977 - September 30, 1978

FUND NAME	*Book Value 10-1-77*	*Change in Book Value from Transactions, Interest, Dividends*	*Receipts*	*Transfer TO*	*Transfer FROM*	*Custodian Charges*	*Expenditures*	*Book Value 9-30-78*
Permanent	$ 85,673.49	$ 7,381.85	$ 500.00	$	$	$ 622.53	$	$ 92,932.81
Freeman	67,047.17	5,776.96				487.19		72,336.94
Turner	3,758.69	323.86				27.31		4,055.24
Fitzgerald	6,225.76	536.43				45.24	200.00	6,516.95
French	3,717.69	320.33				27.01		4,011.01
Herschel	2,401.28	206.90				17.45		2,590.73
Howe	4,107.86	353.94				29.85	24.79	4,407.16
Morse	5,756.07	495.96				41.83	200.00	6,010.20
Walker	1,854.38	159.78				13.48	24.79	1,975.89
Horne	5,501.71	474.04				39.98	200.00	5,735.77
Lectures	6,169.69	531.60				44.83	486.77	6,169.69
Camp	13,565.59	1,168.85				98.57		14,635.87
Brackett			300.00					300.00
Kennison			4,899.16					4,899.16
Inv. Current	2,883.70	248.46		1,136.35	(800.00)	20.95		3,447.56
Totals	$208,663.08	$17,978.96	$5,699.16	$1,136.35	($800.00)	$1,516.22	($1,136.35)	$230,024.98

DISTRIBUTION OF MISCELLANEOUS FUNDS

	Book Value 10-1-77	*Receipts Fiscal Yr.*	*Expenditures Fiscal Yr.*	*Book Value Before Transfers*	*Transfers*	*Book Value 9-30-78*
Continuing Education Fund	$ 3,866.84	$ 3,675.00	$ 2,385.51	$ 5,156.33	$	$ 5,156.33
Boring Data Fund	1,595.81			1,595.81		1,595.81
Student Loan Fund	1,404.24	2,010.00	2,000.00	1,414.24		1,414.24
Group Lecture Series*	12,776.38	30,675.48	15,849.54	27,602.32	(17,843.00)	9,759.32
Dinner Dance	0	1,694.00	1,784.64	(90.64)	90.64	
Clambake	0	2,704.50	2,812.55	(108.05)	108.05	
Technical Group Meetings	0	4,078.00	6,150.00	(2,072.00)	2,072.00	
Entrance Fees	0	500.00		500.00	(500.00)	0
Current Fund	0	54,314.62	65,108.16	(10,793.54)	10,793.54	0
Uninvested Kennison Fund		4,680.32				4,680.32
Corpus	(8,954.38)				5,278.77	(3,675.61)
Totals	$10,688.89	$104,331.92	$96,090.40		0	$18,930.41

TABLE III
DETAILED STATEMENT OF INCOME AND EXPENDITURES
Fiscal Year 10-1-77 to 9-30-78

	Expenditures	*Income*
Prizes, Awards	$ 1,335.78	$
Scholarships, Loans	2,000.00	2,010.00
Dues		20,630.00
Allotment		3,403.00
Bank Interest		1,299.16
Contributions		9,712.47
Entrance Fees		500.00
Publication Sales		5,877.59
Advertising		2,115.00
CECNE Reimbursement		11,532.24
Local Societies	200.00	-
ASCE Conference	30.00	-
Continuing Education	2,385.51	3,675.00
Lateral Earth Pressure L.S.	494.56	745.00
Earthquake L.S.	-	-
Deep Foundations L.S.	110.00	-
Miscellaneous	290.88	1,329.43
Office Services	280.63	-
Welding L.S.	1,998.81	13,842.00
Soil Dynamics L.S.	13,246.17	16,088.48
Office Supplies	1,071.95	-
Postage	2,870.96	-
Telephone	570.45	-
Forum Printing-Newsletter	1,629.05	-
Journal Printing	12,608.64	-
General Printing	4,459.32	-
Annual Meeting & Student Night	3,423.38	1,931.05
Branch Activities	500.00	-
Transfer from Investments	4,899.16	-
Secretarial	1,584.00	
Travel	355.50	
Committee Expense	69.50	
New England Council	329.95	
Insurance	1,981.00	
Salaries, net	13,634.18	
Taxes, State & Federal	7,467.36	
Rent	1,653.55	
Construction Group	369.24	861.75
Environmental Group	459.21	285.55
Geotechnical Group	4,001.97	2,646.58
Hydraulics Group	115.00	-
Structural Group	1,190.13	200.00
Transportation Group	15.00	83.15
Dinner Dance	1,784.64	1,694.00
Clambake	2,812.55	2,704.50
Reprints	725.14	842.81
N.U. Student Chapter Project	1,502.76	-
Bank Charges	-	323.16
Legislative Affairs	1,120.00	-
1979 National Convention	514.47	-
	$96,090.40	$104,331.92

TABLE IV

PORTFOLIO OF INVESTMENTS — SEPTEMBER 30, 1978

Description	*Book Value*	*Market Value*	*Estimated Income*
CASH			
Cash	$11,381.84	$11,381.84	$
Savings Account	11,700.00	11,700.00	840.06
U.S. Treasury Bills	49,072.50	49,072.50	3,430.00
Total Cash	$72,154.34	$72,154.34	$4,270.06
BONDS			
U.S. Government Notes	$20,037.38	$19,647.00	$1,562.50
Federal Agencies	25,085.87	23,850.00	1,970.00
Utility	16,005.09	11,969.97	875.00
Industrial	10,450.00	8,700.00	462.50
Financial	11,000.00	9,202.47	557.50
Foreign Bonds	10,075.00	8,118.70	600.00
Total Bonds	$92,653.34	$81,488.14	$6,027.50
COMMON STOCKS			
Chemical	$ 4,222.50	$ 3,487.50	$ 200.00
Manufacturing	8,629.23	12,150.00	700.00
Drug, Medical	4,968.62	5,525.00	240.00
Food, Beverage	9,592.00	9,000.00	348.00
Machinery, Tools	8,180.00	8,600.00	200.00
Office Equipment	8,431.24	12,465.00	518.40
Oil and Gas	6,983.63	16,275.00	960.00
Tobacco	7,240.63	8,953.13	256.25
Utilities	6,969.45	14,043.75	1,082.00
Total Common Stocks	$65,217.30	$90,499.38	$4,504.65

Report of Action Program-Professional Practice Committee, 1978-1979

This year the Committee consisted of the following members:

Rodney Plourde, Chairman	Transportation Group
Dominic D'Eramo, Vice Chairman	At-Large/Structural Group
Frank Killilea, Clerk	Construction Group
David Gardner	Environmental Group
Howard Perkins	At-Large
Ara Shrestinian	At-Large/Construction Group
David Thompson	Geotechnical Group
John Quinn	Construction Group

The Committee's most active function this year was participation in the five-society Joint Governmental Affairs Service. Retitled the "Design Professionals Joint Governmental Affairs Council," and comprised of two members each from BSCES/ASCE, the Consulting Engineers Council of New England, the Massachusetts Society of Land Surveyors and Civil Engineers, the Massachusetts Society of Professional Engineers and the Massachusetts State Association of Architects, this Council has been engaged in the following activities during this past year:

Review of proposed state legislation affecting its members, and giving testimony, where appropriate, on bills which may affect the responsibilities, privileges, or practice of the engineering profession.

Establishment of closer working relationships with state boards and agencies through meetings and follow-up contacts. This year, the Council initiated dialogues with the Lieutenant Governor's office, the Massachusetts Board of Registration for Professional Engineers and Land Surveyors, the Department of Environmental Quality Engineering, and the Special Commission on State and County Buildings.

Monthly or bi-monthly publishing of a "Governmental Affairs Bulletin" which is mailed to member societies, and contains notices of proposed legislation, coming hearings, reports on meetings, and notices of future meetings.

Legislation reviewed by the Committee in the past year, and the position taken by the BSCES Board of Government, were as follows:

H.5911. (1978): Qualifications of the Director of Building Construction. (In favor.)

S1006. (1979): Establishment of a Standard Set of Wetlands Maps. (In favor.)

S1228. (1979): Registration of Governmental Employees without Examination. (Opposed.)

S1318. (1979): Four-Year Statute of Limitations for Errors, Omissions, Neglect, etc. (In opposition to 4-year limit; too short. Would favor similar legislation with 6-year limit.)

H853. (1979): Enlarging the State Building Code Commission. (In opposition to addition of another building contractor; upsets balance.)

H1430. (1979): Establishing a State Fire Prevention Code Commission. (In favor, with one qualification: addition of one structural-civil engineer.)

H.1994. (1979): Prevention of Frivolous Malpractice Claims. (In favor.)

H.2690. (1979): Urban Renewal Agency Financing of Urban Redevelopment Corporations' Public Facilities Projects. (No position.)

Other major activities of the Committee during the year included the following:

Coordination of BSCES Environmental Group's review of EPA Concept Papers on Implementation of 1977 Amendments to Clean Air Act.

Recommendation of Asaf Qasilbash and Peter Taylor to serve on Soils Advisory Committee, an Advisory Committee to the State Building Code Commission. (Appointments made).

Recommendation of John McSweeney, Harold Glenzel, and Ernest Goodwin to serve on screening panel for new Director of the Bureau of Building Construction. (Glenzel appointed).

Recommendation of Richard Coughlin to serve on Blue Ribbon Commission.

Recommendation to State Building Code Commission that it adopt the language of the BOCA Basic Building Code 1978 with respect to *Section 127.0 Construction Control.*

Continue monitoring progress of the New England Section, Association of Engineering Geologists, toward professional registration of geologists in Massachusetts. (Still under consideration by geologists).

Recommendation of five candidates to Tufts University's search committee for a new Dean of Engineering. (Outcome not yet known.)

Renomination of Richard V. Battles to continue service on Boston Zoning Commission.

Looking ahead into 1979-1980, the Committee should continue to be quite active, especially as a participant on the Design Professionals Joint Governmental Affairs Council.

Respectfully submitted,
Rodney P. Plourde, Chairman

Report of Advertising Committee, 1978-1979.

The activities of the Advertising Committee focused mainly on the procurement of professional ads, for the special convention issue of the Journal.

A communication was sent to the chief executive officer of approximately 210 firms, nationwide, urging support of our publication by placing a professional message in the advertising section of the Journal. This was followed up by phone calls, to some of the local firms as press time approached.

The response was very gratifying, with 55 replies generating about 19 pages of ads.

Assistance of the BSCE Section office staff in compiling and coordinating the returns was a big help and is truly appreciated.

Respectfully submitted,
John P. Hurney, Chairman

Report of Auditing Committee

An audit of the Section checking account was performed for the period 1 October 1977 through 30 September 1978. The audit included the following:

1. An accounting of all checks written including voided, cancelled and lost checks.
2. Review of all bank charges for foreign exchange rates.
3. Review of checks which the Section received for which there was nonpayment.

An accounting of all deposits, interest and bank corrections.

The following items worthy of mention were noted. It was observed that three checks were processed by the bank for amounts differing from the stated values of the checks. The differences were small with the total discrepancy equalling $0.57 more than the designated amounts. It was also noted that four unsigned checks had been issued and processed by the bank.

A calculation of the closing balance commencing with the starting balance and considering the above transactions checked to within $0.02 and indicated no significant discrepancies in the recorded transactions.

Respectfully submitted
Robert L. Meserve, Director
Leo F. Peters, Secretary
Edward B. Kinner, Director

Report of Committee on Awards, 1978-1979

The following prize awards for papers are recommended for the year 1978-1979:

Geotechnical Group Award	- Francis C. Pierce and Victor Calabretta "Unique Challenges Associated with Marine Structures in New England"
Clemens Herschel Award	- David C. Willett "The Use of Underground Space"

The Awards Committee also solicited nominations for the Horne Fund Award for persons who have been outstanding in unpaid public service. The Committee recommends that Dr. Othar Zaldastani be the 1979 recipient of this prestigious award. A summary of Dr. Zaldastani's achievements and services was furnished to the Board of Government.

Respectfully submitted
Edward B. Kinner, Chairperson

Report of Thomas R. Camp Fund Committee, 1978 - 1979

The 1979 Thomas R. Camp lecture was held on March 7, 1979 at the Northeastern University Faculty Center. Mr. Roy F. Weston, president of Roy F. Weston, Inc., was the lecturer, and the subject of his talk was "Environmental Engineer: Where Goeth Thou?" Mr. Weston wished to have his honorarium of approximately $400 sent to the University of Wisconsin Foundation.

Respectfully submitted,
Warren H. Ringer, Chairman

Report of Constitution and Bylaws Committee, 1977-1978

In response to an April 10, 1978 Board of Government request, the Committee prepared a proposed amendment covering changes to Bylaws, ARTICLE 6 — Fees and Dues.

At the two regular meetings of the Section on October 25, 1978 and November 29, 1978, the amendment was approved by the required two-thirds vote in accordance with the requirements of ARTICLE 15 — Amendments.

On April 17, 1978, the amendment became effective, having been approved by the Board of Government.

Respectfully submitted,
Saul Namyet
Max D. Sorota, Chairman

Report of Continuing Education Committee, 1978-1979

The Committee sponsored a series of eleven lectures in the spring and fall of 1978 to assist practicing engineers preparing for the state registration examination. Total enrollment numbered approximately seventy five. Questionnaires were distributed and evaluated on the effectiveness of the course and recommendations incorporated into the program.

Material related to the technical aspects of the course continued to be collected and made available to students and instructors. Correspondence continues with other ASCE Sections concerning complementary endeavors and cooperation.

The chairman of the committee continues to attend meetings of the continuing education committee of the Boston Architectural Society.

Respectfully submitted,
Ronald E. Sharpin, Chairman

Report of Disadvantaged Youth Committee, 1978-79

During the past year the Committee discontinued its program of attempting to place disadvantaged youth in entry level positions with local engineering firms. The program was discontinued because of a very disappointing response to both an article in the BSCES Newsletter and proposals sent directly to firms in previous years.

This year members of the Committee were supportive of and actively involved in the 1978 Summer Institute, "What is Engineering", conducted for minority high school students by ASCE's National Committee on Minority Programs and Northeastern University. The Board of Government has approved the Committee's recommendation for an allocation of $600 to sponsor three youngsters to the three-week 1979 Summer Institute.

The Committee has also distributed, via the BSCES Newsletter, information concerning ASCE's new policy on minority entrepreneurship in engineering and construction.

Respectfully submitted,
Richard J. Scranton, Chairman

Report of John R. Freeman Fund Committee, 1978-1979

On behalf of our Committee, I have the honor to submit the following report:

The Tenth John R. Freeman Memorial Lecture — "The Annual Water Balance" by Peter S. Eagleson, delivered in parts in April-May 1977, was received in February 1979 for publication in the Journal in summary form. With the approval of our Committee, it was also submitted at the same time for publication in the Proceedings of ASCE.

Encouragement was given the Hydraulics Group to proceed with ambitious plans for a lecture series on hydrology during the coming year, with Freeman Fund support.

Respectfully submitted,
The John R. Freeman Fund Committee
Lee Marc G. Wolman, David R. Campbell,
Lawrence C. Neale, Donald R.F. Harleman, Harry L. Kinsel
Lee Marc G. Wolman, Chairman

Report of History and Heritage Committee 1978-1979

Two National Historic Civil Engineering Landmarks in Massachusetts were dedicated during the past year, bringing our total to seven.

On April 10, 1978, the pioneer Dry Dock No. 1 at Charlestown was dedicated with appropriate ceremonies. ASCE President-Elect Walter E. Blessey presented the plaque to the National Park Service. The historic structure is within the new Boston National Historical Park. The U.S. Navy and various maritime historical interests were represented at the ceremonies.

On September 6th, the Boston Subway was dedicated as an NHCEL with ceremonies at the Park Street kiosk of the MBTA where the plaque is located. This designation is most significant since it coincides with the refurbishing of portions of the subway, not as a historical relic, but for the continuing use of this pioneer engineering achievement.

In August we submitted to ASCE's Committee on History and Heritage of American Civil Engineering the nomination for the designation of Harvard Stadium, a world pioneer massive structure of reinforced concrete, as an NHCEL. We are now awaiting the Committee's recommendation to the Board of Direction on this nomination.

In January of 1979 we were contacted by the Museum of Transportation for assistance in evaluating a large collection of early civil engineering plans relating primarily to Boston. The Board of Government has voted support to the Museum of Transportation for establishment of a place where early engineering plans of interest and value can be preserved and made available to engineers, historians and archeologists. Since the new musuem's field is being expanded to include the impact of transportation on the city's growth and development, civil engineering history will be very much involved. Our cooperation in this project should prove very interesting, and in line with the ASCE history and heritage program for greater appreciation of the engineer's contribution to this country's history and development.

Respectfully submitted,
Gary S. Brierley
Jerry Potamis
H. Hobart Holly, Chairman

Report of Key Man Committee, 1978-1979

The Key Man Committee acts as a line of rapid communications between the Section and its members in local firms. Their primary function is to remind members of coming Section meetings or events.

At present there are 65 firms or institutions with key men tied into the committee and the effectiveness in boosting attendance at society functions appears to be quite satisfactory.

Respectfully submitted,
Robert M. Fitzgerald, Chairman

Report of Membership Committee, 1978-1979

Committee members for the year included Philip Caruso, Arthur Franz, Owen MacDonald, and Richard McAllister.

This year the membership committee has given primary emphasis to the implementation of the membership recruitment pogram developed over the last two years and the formulation of new approaches to be used in assuring an increase in local membership for future years.

Key efforts included the sending of follow-up letters to ASCE national members who are non-subscribing members of the Section, sending recruitment letters to non-ASCE and non-BSCES members, and canvassing graduating students at the annual Student Caucus and Student Night Dinner meetings.

New membership incentive programs considered and being prepared for future submission to the Board include imposing a surcharge on non-Section members at Section sponsored activities, modifying the bylaws to allow pofessional engineers without a Bachelor's Degree to more easily advance to a higher grade than currently permissible within the Society and the possibility of having BSCES sponsor various non-technical events at reduced rates for local members.

This committee strongly feels that both continued effort in the existing membership recruitment program and the future adoption of new approaches such as those considered above will help assure increased local Section membership and participation.

Respectfully submitted,
Philip J. Caruso, Chairman

Report of the Nominating Committee, 1978-1979

The Nominating Committee met on October 26, November 16, December 6, and December 21, 1978.

The Section's nominees for membership on ASCE national professional committees were submitted to National in January 1979, as follows:

Committee on Programs for Professional Services	Bertram Berger
Committee on Curricula and Accreditation	Charles C. Ladd
Committee on Minority Programs	Michael Kupferman
Committee on Employment Conditions	Howard Simpson

The slate of officers of the BSCE Section for 1978-1979 is hereby submitted.

President	William S. Zoino
Vice President (Two-year term)	Edward B. Kinner
Secretary	Leo F. Peters
Treasurer	Norman W. Bennett
Directors (Two-year term)	Peter K. Taylor
	Paul J. Trudeau
Nominating Committee (Elect three)	Franklin B. Davis
	Richard DiBuono
	Roger F. Gardner
	Frank Heger
	Warren H. Ringer
	Ronald E. Sharpin

All nominees were contacted and their consent to serve was obtained.

Albert G.H. Dietz of MIT was placed in nomination for Honorary Membership in ASCE.

The Committee received and acted upon Saul Namyet's request to be relieved of his Treasurer's duties. The Section is indebted to him for the services he has performed over the past several years.

Respectfully submitted,
Charles A. Parthum, Chairman
Nominating Committee

Report of Operations Manual Committee, 1978-1979

The Operations Manual Committee prepared revisions to the Manual required by actions of the Board of Government during the past year. Recommended changes and additions included:

1. Replacement of the FORUM with a periodic Newsletter.
2. Addition of a Lecture Series Committee.
3. Incorporation under a new Social Functions Committee of the activities of the former Annual Meeting, Clambake, and Dinner Dance Committees.
4. Renaming the Student Chapter Committee as Student Affairs Committee and expanding its role to include Student Clubs.

The Committee's recommendations were approved by the Board of Government and made known to users of the Manual in December 1978.

Respectfully submitted,
Edward B. Kinner
Chairperson

Report of Program Committee, 1978-1979

The Program Committee met on two occasions to plan and coordinate the schedule of Technical Group meetings for the year. A total of 33 meetings were scheduled by the seven Technical Groups; three of the meetings were conducted jointly by two Groups. The Program Committee also arranged scheduling for the Section's Annual Meeting and Student Night.

It has generally been possible to retain the tradition of scheduling technical meetings on Wednesday evenings to avoid conflict with lecture series and other special meetings of the

Section. The presence of the National Convention in Boston in April made this somewhat more difficult as the Technical Groups preferred not to hold meetings in the weeks just prior to or following the Convention. Nevertheless, only seven of the 33 meetings were held on other than Wednesday dates and on only one occasion was it necessary to schedule more than one Group meeting on the same night.

At the beginning of the year, several Group chairpersons expressed concern over the format that had been adopted in recent years for meeting notices. An opinion was expressed that placing multiple notices on a single page detracted from each Group's ability to publicize its meeting, and thus led to a declining attendance. In response to this concern, Stan Rossier and Frank Perkins reviewed attendance data from the years prior to and following adoption of the new format. These data showed large variations in attendance from one meeting to another, but were inconclusive concerning the effect of the notice format. Technical Group chairpersons were also asked to poll those in attendance to get some sense of the impact of the format of the notices. These polls were also inconclusive, but certainly indicated that the format was not a major determinant of attendance. The issue was resolved by adopting a format in which not more than three meetings are publicized on a single sheet.

The Program Committee also served as the Lecture Series Committee. Unfortunately, none of the Technical Groups planned to conduct a lecture series during the past year. It is believed that the large effort directed to planning the National Convention was a significant factor in this decision. A full program is planned for the coming year with the Geotechnical and Structural Groups currently preparing Lecture Series for the fall, and the Environmental Group tentatively preparing plans for next spring.

Respectfully submitted,
Frank E. Perkins, Chairman

Report of Publications Committee, 1978-1979

The following summarizes the activity of the Publications Committee from April 1978 to March 1979.

Quarterly *Journal* Issues	4
Papers received	9
Papers rejected	None
Papers accepted, published or in press	7
Papers under review	2
Monthly *Newsletter* Issues	8

Pursuant to the recommendations of the 1978 BSCES Ad Hoc Budget Committee the Publications Committee undertook the task of upgrading and modernizing the format of the *Journal*. The January 1979 Issue is the first with the new format. This "Special" issue was also coordinated with the April 1979 ASCE National Convention and Exposition held in Boston and 7,000 copies were printed. The new style and format will be utilized in future issues. There are normally about 2,150 subscribers to the *Journal*, about 300 of them being non members, mostly libraries.

The Publications Committee acknowledges the contributions of its Editor of the *Journal*, Mr. Edward C. Keane, and the Editor of the monthly *Newsletter*, Mr. Leo Peters. Special thanks are also due to Mrs. Charlotte Dalrymple for her assistance throughout the year.

Respectfully submitted,
William S. Zoino, Chairman
Robert Snowber, Member
Edward Wood, Member

Report of Social Functions Committee

Establishment of Committee — In 1977 an ad hoc committee on social functions was established to review recent social function activity and make recommendations on the extent and responsibility for future affairs. Following a survey of members the establishment of a standing Social Functions Committee to handle the clambake, annual dance and annual meeting was recommended. This was formally adopted as a revision to the Operations Manual in November, 1978. In May of 1978 President Simpson appointed Robert A. Snowber as Chairman of the committee.

Committee Members — In the above mentioned survey 19 members indicated an interest in serving on the Social Functions Committee. From this list the Chairman selected 10 individuals who assisted in the two social functions summarized below. Other volunteers were also contacted and should be called upon for future activity.

Clambake — Bob Barton headed a special committee for the annual clambake; members included William Collins, Walt Toner, Dave Freed and George Brattin. The clambake was held on Tuesday, August 1 at the Concord Rod and Gun Club, with an attendance of 195. It was a financial and social success. A profit of approximately $150 was realized. Door prizes, both donated and purchased, added a great deal to the party. It is strongly recommended that the Concord Rod and Gun Club be utilized again with the same caterer, with door prizes and the possible addition of music.

Valentine Dance — Consideration had been given to a fall dance but it was decided to defer it until after Christmas but well in advance of the national convention. Robert A. Snowber headed a committee which included John Keating, Mike Powers, Jim Stanzenberg, Van Bares, and Ed Condon. The dance was held at the Great Hall of Quincy Market on February 10 at a low-budget price of $10 a couple; no dinner. Two hundred ten people attended; there was a financial loss of about $50. It was, however, a definite social success and the location, orchestra and door prizes added to the success. Door prizes were donated by firms solicited by letter.

Recommendations — The Committee feels combining the responsibility under one committee is a definite improvement. The clambake should be continued and a dance established as an annual activity of the late fall or early new year. In order to attract younger members this should not be a dinner dance which might cost as much as $40 a couple. With the national convention being in Boston in early April, 1979, with many activities of its own, it was decided to postpone the Section's annual dinner until later in April.

Respectfully sumitted,
Robert A. Snowber, Chairman

Report of Student Affairs Committee, 1978-1979

Membership — The 1978-1979 Student Affairs Committee included Roger Gardner (Chairman), Michael Kupferman, John Roma, Charles Rosselli, Richard Scranton, and Paul Trudeau.

Name Change — By vote of the Board of Government, the name of this committee was changed from the "Student Chapter Committee" to the "Student Affairs Committee." The new name more accurately reflects the purpose and function of this committee.

Summary of Activities — This years activities included the following:

- Sponsoring a student caucus held at Southeastern Mass.
- Sponsoring a Special Meeting for students, held at Tufts.
- Soliciting donations from area firms to improve the student loan fund.
- Providing additional Contact Members for local student chapters.
- Acting as a liaison between local ASCE Student Chapters/Clubs and the BSCE Section.

Student Caucus — On October 12, 1978, a student caucus was held at Southeastern Massachusetts University. Joseph Ward, President-elect of ASCE, gave a presentation on the "Role of the Student Chapter in ASCE." The SMU student chapter provided excellent facilities and refreshments. A total of 55 students and professionals attended. Schools represented at the caucus included Franklin Institute, Merrimack College, Northeastern University, SMU, Wentworth Institute, and Tufts University. Following Mr. Ward's presentation, students and professionals formed small groups to discuss various points of interest to the students, and how the professional community could be of service to the student chapters. All in attendance at this caucus agreed the caucus was interesting and worthwhile.

Special Meeting — On March 1, 1979, a special student dinner was held at Tufts University in cooperation with the BSCE Section Technical Groups, with 138 students and 54 professionals in attendance. Following the dinner, Roger Gardner and BSCE Section President Howard Simpson presented the following awards:

AWARDS	RECIPIENTS
ASCE Certificates for Outstanding Service to the Student Chapters of:	
Northeastern University	Richard Scranton, Faculty Advisor Michael Kupferman, Faculty Advisor Robert Snowber, Contact Member Allen Hatheway, Contact Member Richard Guzowski, Past Contact
University of Massachusetts	William W. Boyer, Faculty Advisor Lee Webster, Contact Member James A. Wesoloski, Past Contact Member
Desmond Fitzgerald Scholarship ($200)	Carl Dumas, Northeastern University
William P. Morse Scholarship ($200)	Margot E. Malin, Tufts University
BSCES Student Loan ($1,000)	Rick L. Wade, Northeastern University
BSCES Student Loan ($1,000)	Daniel E. Hardin, Northeastern University
Howe-Walker Student Awards	John Di Bitetto, Merrimack College Luca Serdar, Mass. Inst. Tech. Heather Mackey, Northeastern Univ. Michael Bissonnette, Northeastern Univ. Daniel F. Coughlin, Southeastern Mass. Univ. Mark J. DeViney, Tufts Univ. Michael A. Trainque, Univ. of Lowell Stephanie G. Barry, Univ. of Mass. John J. Minihan, Wentworth Inst. James J. Wilbur, Worc. Poly. Inst.

Guest speaker for the Special Meeting was Dr. Patrick Malone, Director of Slater Mill Historic Society and a lecturer at Brown University, who presented a talk on the development of water power in Lowell.

Although students outnumbered practicing engineers 3 to 1, there was good interaction between students and engineers during the social hour and dinner. The turnout of professionals this year represents a marked improvement over previous years, but this committee hopes for an even greater turnout next year. In an effort to draw practicing engineers, members of this committee attended Technical Group meetings during December and January to announce the March 1 Special Meeting.

Student Loan Fund — This year, the Student Affairs Committee continued the task of soliciting funds for the interest-free student loans presented each year at the Special Student Meeting. Solicitations were made to over 600 firms in Massachusetts. Special thanks are extended to the following firms for their generous donations:

Curran Associates, Inc.
Richard J. Donovan, Inc.
Thomas K. Dyer, Inc.
Fay, Spofford & Thorndike, Inc.
Geotechnical Engineers, Inc.
Goldberg, Zoino, Dunnicliff & Associates, Inc.
Haley & Aldrich, Inc.
Harvey & Tracy Associates, Inc.
Mr. Francis H. Ledgard
CE Maguire, Inc.
Chas. T. Main, Inc.
Sippican Consultants International, Inc.
Stone & Webster Engineering Corp.
Symmes, Maini, & McKee, Inc.
Whitman & Howard, Inc.
Abraham Woolf & Associates, Inc.

Contact Members — During this past year, this committee helped place a number of contact members at various schools. The committee has maintained contact with student chapters and has made itself available to aid in chapter activities.

Student Engineer Liaison — The aforementioned activities were complemented by continued communication between Student Chapters and Student Clubs, and members of both the BSCE Section and ASCE National. In the coming year, this committee hopes to continue to act as the medium through which the Boston Society of Civil Engineers Section of ASCE and local Student Chapters or Clubs can help one another, and to bridge the communication gap between practicing engineers and students.

Respectfully submitted,
John R. Roma, Secretary
Roger F. Gardner, Chairman

Final Report of Committee for ASCE National Convention & Exposition, 1979

On April 1-6, 1979, the spring convention of the American Society of Civil Engineers was held at the Sheraton-Boston Hotel. This convention was hosted by the Boston Society of Civil Engineers Section and was attended by more than 3600 members, spouses, students and exhibitors.

The convention and exposition offered the members more than ninety technical sessions, featuring a specialty conference on structural design of nuclear power plants. The program also included mini-conferences for many other technical divisions. Total sessions attendance was the second highest in ASCE history at 4876, second to San Francisco at 5544. The average attendance at sessions was 53.

Noteworthy speakers were included in the program; among them were Senator Muskie of Maine, Governor Edward King of Massachusetts and Deputy Secretary Alan Butchman of the United States Department of Transportation.

The program also included field trips to Charles River Dam, Boston Harbor, Massachusetts Institute of Technology, Greater Lawrence Sewage Treatment Facility, Seabrook Nuclear Plant and the MBTA Red Line Extension. The spouses program included trips to Newburyport, Concord, Lexington, Boston Harbor and various museums.

A record-breaking number of students (609) attended the sessions and participated in the activities offered by the convention. The students and their colleges put together theme exhibits in the exposition area. Seven colleges participated in this unusual event. The technical program also included presentations by students as finalists in the Daniel W. Mead student paper contest.

Introduced to the convention for the first time were exhibits by environmental groups. The Appalachian Mountain Club, Conservation Law Foundation of New England, Inc., Friends of the Earth, Massachusetts Audubon Society and the Sierra Club participated by meeting and discussing their programs with members of ASCE.

The BSCE Section committee raised almost $18,000 from approximately one hundred firms, agencies and individuals. These funds were used to cover the costs for hosting many of the functions held throughout the week.

Of particular significance was the special edition of the BSCE Section Journal, containing Convention Highlights, Landmarks of Civil Enginering in New England and the History and Progress of BSCE and the BSCE Section, ASCE, from the year 1848 to the present.

Despite the many adverse factors such as the hotel fire on the day before the convention commenced, power failure in the hotel for two days, United Airlines strike, the teamster's strike preventing delivery of exhibitors' displays, the headlines in the newspapers regarding the Pennsylvania Three Mile Island nuclear power mishap, two thousand protesters milling around the hotel objecting to nuclear power, and a full week of cold and rainy weather, the members took full advantage of all the technical and social functions.

The convention offered the members and spouses a full week of social activities in which to renew acquaintances and make new friends. Included were the following:

A special reception on Saturday night; Cranston Rogers, Zone 1 Vice President and wife, Francine hosted national officers and wives, ASCE Staff, the Boston Section Officers and the Convention Committee.

President Simpson welcomed, on Sunday evening, more than 200 guests at the Boston Aquarium. Mementos were presented to ASCE President Walter E. Blessey, President-elect Joseph Ward and Chairman, Bertram Berger.

ASCE/BSCE hosted more than two thousand members and spouses at the Ice Breaker Party which featured complimentary delicacies of the New England area.

Tuesday evening was set aside for alumni dinners of the local colleges and other groups. The Universities of Rhode Island, Lowell and Massachusetts, also Worcester Polytechnic Institute, Northeastern University, Massachusetts Institute of Technology, Tufts University, Rensselaer Polytechnic Institute and Norwich University met at the hotels or on campuses, and the Civil Engineer Corps of the U.S. Navy met at the USS Constitution Museum.

More than two thousand members and guests attended the complimentary Pops Concert on Wednesday evening at Boston Symphony Hall. Guest Conductor was Newton Wayland; his wife, Jan Curtis, was guest soloist.

More than four hundred members and spouses attended a reception that was held for members and guests at the Great Dome, Quincy Market, on Thursday evening. A complimentary buffet was served.

The committee introduced many innovative features in this convention, and their impact is evident from the accomplishments listed, as compared to other conventions:

- Largest Convention Steering Committee
- Largest spring convention
- Largest student registration

- Largest (two) luncheon attendance
- Largest volume of publication sales
- Second largest convention registration ever
- Second largest total session attendance
- Second largest spring spouse registration

The success of this convention is directly attributable to more than fifty committee members who gave their time and efforts over a period of two years.

To each of them I am personally indebted.

Respectfully submitted,
Bertram Berger, Chairperson

AND

Edward B. Kinner	Program, Vice Chairperson	Sandra Johnson Cointreau	Sessions Assistants
S. Frances Berger	Ladies Programs	Anthony Di Sarcina	Sessions Assistants
Judith Nitsch Donnellan	Exhibits	Prof. Frank Perkins	Speakers
Rubin M. Zallen	Exhibits	Prof. Richard Scranton	Student Program
Michael T. Gruenbaum	Publicity	Prof. Michael Kupferman	Student Program
Cranston R. Rogers	Speakers	Prof. Lew Edgers	Student Program
Robert B. Barton	Activities	David Deans	Student Program
Thomas K. Liu	Technical Program	Wallace Stickney	Excursions
Joseph Lavin	Social Events	David W. Gates	Excursions
Philip J. Caruso	Attendance	Morris Root	Excursions
John T. Christian	Technical Program	John B. McAleer	Excursions
Paul J. Trudeau	Attendance	Barry A. Patrie	Excursions
Bruce Campbell	Professional Program	Stanley Rossier	Professional Program
Joseph L. Ignazio	Reception	Herbert G. Spooner	Younger Members
Estelle Shuman	Graphics	Judith Kinner	Hospitality
Joseph MacDonald	Transportation	Harriet Simpson	Hospitality
Charles A. Parthum	Social Events	Marsha Weiss	Hospitality
Dalton L. Baugh	Publicity	Mary Cusack	Hospitality
Alfred Howard	Field Trips	Leo De Marsh	Transportation
Carol Hogan	Ladies Programs	H. Hobart Holly	History and Heritage
Robert D. Vanasse	BSCES Journal	William Zoino	BSCES Journal
John J. Cusack	Program, Vice Chairperson	Edward C. Keane	BSCES Journal
Brian Hogan	Activities, Vice Chairperson	Edward Wood	BSCES Journal
Richard D. Bedard	Finance	Robert Snowber	BSCES Journal
Martin Weiss	Field Trips	David Weiner	Social Events

Report of the Computer Group, 1978-1979

The following served on the Executive Committee:

Salvatore G. Mazzotta	Chairman
Robert A. Wells, Jr.	Vice Chairman
John D. Goodrich	Clerk
Glenn Orenstein	Member
Mukti Das	Member
James N. Jackson	Member

The first three meetings were held at the MIT Faculty Club in Cambridge, preceded by dinner. The fourth meeting was held jointly with the Structural Group at MIT's Center for Advanced Engineering Studies. The following topics were discussed:

November 1, 1978 — Computer Graphics Applications in the Production Environment. Dr. Wayne W. Black of Chas. T. Main, Inc. addressed two major application areas of computer graphics: data capture and computer-aided drafting. The discussion touched briefly on the equipment used, but was mostly on actual accomplishments. Examples included interdisciplinary checking, material take-offs, engineering drawings, maps and map-related records. Dr. Black presented sample drawings that illustrated each aspect of his talk. Attendance 25.

November 29, 1978 — Electronic Office of the 1980's. Mr. Martin Ernst of Arthur D. Little, Inc. described the office of the future as one where capital replaces today's labor, where electronic gear is used routinely by clerical personnel and top management, and where there is a substitute for the paper medium. The reasons for this future office were stated as 1) large amounts of filed information, 2) regulatory control, 3) reduction in word-skills of clerical help, 4) amount of time spent in internal communications, and 5) anticipated shortage of workers. The components of such an office exist today in facsimile, PABX, smart copiers, computers, communications, etc., but no manufacturer has offered a system that integrates these components. Mr. Ernst estimates that within 3 to 5 years office systems will be available from major suppliers, and that within 8 to 10 years they will be used by many offices. Attendance 18. This was also an official meeting of the BSCE Section, ASCE.

February 14, 1979 — Dynamic Modeling of Water Quality in Urban Drainage Canals. Messrs. Richard E. Moore and David Bingham of Metcalf and Eddy, Inc. described the modeling of tidally-affected drainage canals near Savannah, Georgia, for the purposes of an environmental study. The analysis of the canals for both point and non-point pollution sources was described. In addition, the significant factors in the local geography and environment which impacted the study were discussed. The objective of the study was to present to the City of Savannah a program to reduce pollution in the canals.

The analysis was carried out by use of a one-dimensional finite element water quality model which was implemented on a digital computer. Use of this model pointed out the most cost-effective measures to be taken and also made obvious the effect of certain geological features, such as the storage capacity of adjacent swamp land. Attendance 12.

March 14, 1979 — A Practical Finite Element Primer. Prof. Klaus-Jürgen Bathe of the Department of Mechanical Engineering of M.I.T. first reviewed the displacement method of formulating structural analysis for trusses. He then compared this with the formulation of a two-dimensional finite element analysis problem. He went on to discuss the steps required to use finite element techniques on engineering problems, namely 1) determine if FE analysis is appropriate, 2) establish the FE model, 3) run model on computer, and 4) interpret results. Finally, Prof. Bathe showed slides of several problems he has solved using FE analysis. The meeting was held jointly with the Structural Group. Attendance 45.

The following were elected at the February 14, 1979 meeting as committee members for 1979-1980:

Robert A. Wells, Jr.	Chairman
John D. Goodrich	Vice Chairman
Glenn Orenstein	Clerk
Mukti Das	Member
David Alschuler	Member
Salvatore G. Mazzotta	Member

Respectfully submitted,
Salvatore Mazzotta, Chairman

Report of Construction Group, 1978-1979

The Executive Committee this year consisted of the following:

Chairman	Stephen G. Walker
Vice Chairman	John R. Roma
Clerk	(Vacant)
Member	John P. Sullivan
Member	Norman Bennett
Member	Laimonis Rieksts

The following meetings were held during the past year:

October 24, 1978 — Dinner meeting at Northeastern University. Mr. Marvin Gates, Principal of Gates-Scarpa and Associates, spoke on "Bidding and Estimating." Officers for 1978-1979 were elected at this meeting. Attendance 19.

January 10, 1979 — Dinner meeting at the Cottage Crest. Waltham. James J. Myers, Esq., a partner in the law firm of Gadsby & Hannah, Inc., spoke on the owner's (and general contractor's) concerns about subs and suppliers' right to payments. Attendance 17.

March 14, 1979 — Dinner heeting at the Cottage Crest, Waltham. Rudi Idzojtic, Contracts Administrator for Perini Corp., spoke on "Construction Delays and Impact on Schedule: Analyzing the contractor's request for a time extension, and impact damages." Attendance 16. This was also an official meeting of the BSCE Section, ASCE.

In May, a joint meeting will be held with the Geotechnical Group, at which time the Construction Group will elect officers for 1979-1980. The slate of the nominating committee is as follows:

Chairman	John R. Roma
Vice Chairman	Charles A.Rosselli
Clerk	Robert D. Lignowski
Member	Stephen G. Walker
Member	John P. Sullivan
Member	Norman W. Bennett

Respectfully submitted,
John R. Roma, Vice-Chairman

Report of Environmental Group, 1978-1979

The Executive Committee this year consisted of the following members:

Chairman	Warren H. Ringer
Vice Chairman	Benjamin J. Fehan
Clerk	Steven H. Corr
Member	Gerald C. Potamis
Member	James O'Shaughnessy
Member	Edward Boyajian

The following meetings were held during the past year.

October 18, 1978 — Joint meeting with Hydraulics Group included a tour of the Cohasset, Massachusetts Water Treatment Plant, Aaron River Dam and Reservoir and Second Brook Control Structure. Dinner was held at Hugo-Kimball's, Cohasset Harbor, followed by discussions by Arthur Vulgeropolous on hydrological studies concerning the project and by Frederick G. Aufiero of SEA Consultants, Inc. concerning the design and construction of the treatment facilities. Attendance 47.

January 18, 1979 — Dinner meeting at Purcell's Restaurant. John Smith, Chief, Urban Systems Management Section, EPA, Cincinnati, spoke on innovative and alternative systems for wastewater treatment facilities. Attendance 70.

March 7, 1979 — Dinner meeting at Northeastern University Faculty Center, Kerr Hall. This was the 7th Annual Thomas R. Camp Lecture. Roy F. Weston, President, Roy F. Weston, Inc. spoke on "Environmental Engineer: Where Goeth Thou?".

This was also the Environmental Group's Annual Meeting. The following officers were elected for the coming year:

Chairman	Benjamin J. Fehan
Vice Chairman	Steven H. Corr
Clerk	Gerald C. Potamis
Member	James O'Shaughnessy
Member	Edward Boyajian
Member	Richard K. Smith, Jr.

Attendance 35.

May 23, 1979 — The annual outing of the Environmental Group will be a field trip to the Upper Blackstone Water Pollution Abatement District treatment plant near Worcester, Massachusetts. George M. Reece, Vice President and Director, Fay Spofford and Thorndike, Boston, and Emil Holland, Engineer Director of the District, will be dinner speakers.

Respectfully submitted,
Warren H. Ringer, Chairman

Report of Geotechnical Group, 1978-1979

Officers for the Geotechnical Group in 1978-1979 were:

Chairman	David E. Thompson
Vice Chairman	Anthony C. Barila
Clerk	Joseph D. Guertin, Jr.
Member, Executive Committee	Asaf A. Qazilbach
Member, Executive Committee	Lewis Edgers
Member, Executive Committe	Joseph J. Rixner
Chairman, Forum Committee	James W. Weaver

During the year the Group held the following meetings:

May 23, 1978 — "Offshore Development". A joint presentation by Mr. Robert E. Smith and Mr. F. Pierce. Presiding was Mr. Asaf A. Qazilbach. Attendance 60.

September 26, 1978 — "Filter Fabrics". A joint presentation by Mr. Robert Barrett and Mr. J. Robert Carroll. A geotechnical forum committee meeting presided over by Mr. James W. Weaver. Attendance 50.

October 25, 1978 — "Cone Penetrometer". A lecture by Dr. John Schmertmann of the University of Florida. Presiding was Mr. David E. Thompson. Attendance 80. This was also an official meeting of the BSCE Section, ASCE.

November 30, 1978 — "Reinforced Earth". A joint presentation by Mr. David McKittrick of Reinforced Earth Company, Mr. John Aherne of the Massachusetts Department of Public Works and Mr. Thomas Tsotsi of CE Maguire. A geotechnical forum committee meeting presided over by Mr. James W. Weaver. Attendance 72.

January 17, 1979 — "Proposed Revisions to the Massachusetts Building Code". A joint presentation by Mr. Donald T. Goldberg of Goldberg, Zoino, Dunnicliff & Associates, Inc., Mr. William Hagen of LeMessurier Associates, Mr. Edmund Johnson of Haley and Aldrich, Inc. and Dr. S.J. Poulos of Geotechnical Engineers, Inc. A geotechnical forum committee meeting presided over by Mr. James W. Weaver. Attendance 30.

February 20, 1979 — "Dam Inspection Program". A joint presentation by Dr. Harl P. Aldrich, Jr. of Haley and Aldrich, Inc., Mr. E. Perkins Gould of the U.S. Army Corps of Engineers, Mr. Warren Guinan of Anderson Nichols & Co., Inc., and Dr. Ronald C. Hirshfeld of Geotechnical Engineers, Inc. A geotechnical forum committee meeting presided over by Mr. James W. Weaver. Attendance 100.

March 21, 1979 — "Selection of Stabilization Measures for Shallow Underground Openings in Rock". A lecture by Dr. Tor L. Brekke of the University of California at Berkeley. Presiding, Mr. David E. Thompson. Attendance 68.

April 26, 1979 — "Lateral Loads on Piles and Caissons". A lecture by Dr. Thomas Davisson of the University of Illinois. Attendance 46.

All of the above meetings were held at Tufts University with the exception of Dr. Schmertmann's lecture which was held at Blossom's in the West End restaurant.

Lecture Series The Geotechnical Group is planning a lecture series on dams scheduled for the fall of 1979. Mr. Alton Davis, of Chas. T. Main, Inc., has accepted the position as Chairman of the Lecture Series Committee.

Officers and Executive Committee members for 1979-1980 are as follows:

Chairman	Anthony C. Barila
Vice Chairman	Joseph D. Guertin, Jr.
Clerk	Asaf A. Qazilbach
Member, Executive Committee	Lewis Edgers
Member, Executive Committee	Joseph H. Rixner
Member, Executive Committee	James W. Weaver

Respectfully submitted,
Joseph D. Guertin, Jr., Clerk

Report of the Hydraulics Group, 1978-1979

The Executive Committee for this year consisted of the following members:

Chairman	Richard DiBuono
Vice-Chairman	Reynold Hokenson
Clerk	Russell Peterson
Member	Robert H. Taylor, Jr.
Member	Prof. Antonis Koussis
Member, Past Chairman	Thomas Doucette
Member, Past Chairman	Edward Dunn

September 27, 1978 — John Desmond of Francis Associates, Cambridge, and Louis Garibaldi, Director of Operations at the New England Aquarium, Boston spoke about the design, construction, operation and maintenance of the water processing facilities of the Aquarium. The evening meeting was held at the Aquarium and included a tour of the hydraulic facilities. Attendance 55. This was also an official BSCE Section meeting.

October 18, 1978 — Conducted jointly with the Environmental Group, the meeting included an afternoon tour of the Cohasset, Mass. Water Treatment Plant, Aaron River Dam and Reservoir, and Second Brook Control Structure and an evening meeting at Hugo's Lighthouse Restaurant, Cohasset. Lectures were presented by Frederick G. Aufiero, Associate, SEA Consultants, Inc., Boston, who presented the environmental engineering aspects of the design and construction of the water treatment plant and Athanasios Vulgaropulos, Consulting Civil and Hydraulic Engineer who spoke about the hydrologic and hydraulic aspects of the design and construction of the dam and reservoir, and the flow control structure. Attendance 54.

December 6, 1978 — A joint presentation on the development of low head hydropower in New England was made by John J. Fairfield, Manager of Projects and Jack C. Howe, Mechanical Engineer, both of Chas. T. Main, Inc., Boston. Mr. Fairfield discussed existing and potential low head hydroelectric development in New England and Mr. Howe spoke on recent hydraulic turbine developments for low head applications. The evening meeting was held at the Ralph M. Parsons Water Resources Laboratory at MIT. Attendance 65.

January 31, 1979 — M.B. McPherson, Director of the ASCE Urban Water Resources Research Program spoke about urban runoff control planning. Mr. McPherson focused on the current status of urban runoff control planning in the United States and briefly outlined the history and progress of the ASCE UWRR Program. The evening meeting was held at the Ralph M. Parsons Laboratory at MIT. Attendance 30.

March 14, 1979 — An evening tour of WPI's Alden Research Laboratory (ARL), Holden, Mass., including the demonstration of an operating hydrothermal model of a nuclear power plant cooling water discharge structure, was followed by a lecture on the physcial and analytical modeling of the Seabrook (NH) Nuclear Power Plant cooling water system by Professor George E. Hecker, Director of ARL. Prof. Hecker summarized the various studies conducted at ARL to help evaluate the operational characteristics and environmental effects of the cooling water intake and discharge structures. Attendance 33.

May 2, 1979 — "Design, Construction and Operation of Pump Test Facility" will be the topic to be presented by Jonathan W. Leavitt, Chief Test Engineer, CE-KSB Pump Co., Inc. and Edward Dunn, Asst. Vice-President, CE Maguire, Inc. at an evening meeting in Portsmouth, NH. The meeting will be preceded by an afternoon tour of the test facility in Newington, NH. Election of Hydraulic Group officers for 1979-1980 will be conducted at the meeting. The slate of the Nominating Committee is as follows:

Chairman	Reynold Hokenson
Vice-Chairman	Russell Peterson
Clerk	Robert H. Taylor, Jr.
Member Executive Committee	Prof. Antonis Koussis
Member Executive Committee	Edward P. Dunn
Member Executive Committee	Richard DiBuono

Respectfully submitted,
Richard J. DiBuono, Chairman

Report of the Structural Group, 1978-1979

The Executive Committee this year consisted of the following members:

Chairman	Franklin B. Davis
Vice President	Richard A. Foley
Clerk	James M. Becker
Member-at-Large	Kenneth B. Wiesner
Member-at-Large	Maurice A. Reidy
Student Member	Luka Serdar, MIT
Immediate Past Chairman	Frank J. Heger

The meetings held by the Structural Group were as follows:

October 4, 1978 — Mr. Edward J. Teal, Structural Consultant, Los Angeles, presented the A.I.S.C. 1978 T.R. Higgins Lectureship Award paper entitled "Seismic Design Practice for Steel Buildings". Mr. Teal's lecture presented state-of-the-art design concepts for the aseismic design of steel buildings. His lecture was particularly relevant because of his personnal experience as a design engineer. The evening meeting was held at Northeastern University. Attendance 175.

December 13, 1978 — A panel discussion was held in regard to the problems associated with the retrofitting of bridges. The panel moderator was Robert Tierney, Chief Engineer of the Massachusetts Department of Public Works. The panel consisted of John Aherne, Bridge Engineer, Massachusetts Department of Public Works; Lawrence McCloskey, Chief Engineer, Universal Engineering Corp.; and Paul Maimoni, Project Manager, J.F. White Contracting Co. Meeting consisted of introductory remarks by Mr. Tierney in which he discussed the bridge upgrading program of the Department, and a panel discussion during which various problems associated with the bridge upgrading program were aired. The DPW's point of view was expressed by Mr. Aherne; the consultant's approach was discussed by Mr. McCloskey, and the contractor's view

was presented by Mr. Maimoni. The evening meeting was held at the Student Center of Northeastern University. Attendance 75. This was also an official meeting of the BSCE Section, ASCE.

February 28, 1979 — Mr. William LeMessurier, President, LeMessurier Associates/SCI presented a talk on design for Middle East construction. Mr. LeMessurier gave a talk based upon his firm's experiences in the Middle East. His emphasis was on the organization for design rather than on the technical aspects. The presentation was highlighted by a film about one of their major projects. The evening meeting was held at the Student Center of MIT. Attendance 65. This was also an official meeting of the BSCE Section, ASCE.

March 14, 1979 — Professor Klaus-Jürgen Bathe, Department of Mechanical Engineering, MIT, presented a talk entitled "A Practical Finite Element Primer". Prof Bathe's talk presented an overview of the finite element method for practicing engineers who had not already been exposed to it. This meeting was held jointly with the Computer Group. The evening meeting was held in Room 9-150 at MIT. Attendance 45.

Elections were held at the March 14th meeting for members of the Executive Committee for 1970-1980. Elected were:

Chairman	Richard A. Foley
Vice Chairman	James M. Becker
Clerk	Kenneth B. Wiesner
Member-at-Large	Maurice A. Reidy
Member-at-Large	Thomas Tsotsi
Student Member	Bruce Wile, Northeastern
Immediate Past Chairman	Franklin B. Davis

During the year, meetings of the Executive Committee were held to plan regular meetings and to discuss other matters. Plans were started for a lecture series to be held during the Fall of 1979 entitled, "Structural Renovation and Rehabilitation of Existing Buildings".

Respectfully submitted,
James M. Becker, Clerk

Report of the Transportation Group 1978-1979

The Executive Committee this year consisted of the following members:

Chairman	A. Russell Barnes, Jr.
Vice President	Rocco A. Mancini
Clerk	Edmund J. Condon
Member	Robert A. Snowber
Member	Thomas F. Humphrey
Member, Past Chairman	Robert J. McDonagh
Representative to JRTC	Marvin W. Miller

The following meetings were held during the past year:

May 24, 1978 — Federal Transportation Policy as Represented in the 1978 Federal Transportation Bill. Mr. Lester P. Lamm, Executive Director of the Federal Highway Administration, described the government's approach to funding for highway and transit projects. The various versions of the bill from the Senate and the House of Representatives were discussed. The meeting was a luncheon session held at Purcell's Restaurant. Attendance 56.

September 20, 1978 — The New Boston. Barney Frank, a Massachusetts State Representative whose district covers a portion of Boston, spoke on the recent developments in the city including Park Plaza and the Washington Street Mall. He focused on three additional topics: a) The problems faced in public impovement with the "not near me" syndrome; b) The restriction of the automobile in center city; and c) Improvement of MBTA service to Boston. The luncheon meeting was held at Nick's Restaurant. Attendanct 36.

November 16, 1978 — The Central Artery Utility Research Project. Mr. Paul Levy, Partner, Storch Engineers, spoke on the utilities inventory made in connection with the proposed project for depression of the Boston Central Artery, including data research and storage on computer cards for later retrieval. The meeting was a joint luncheon with the Boston Transportation Group. Attendance 139.

January 24, 1979 — Surface Transportation Act of 1979. Mr. George M. Joseph, Director, Capital Expenditures Program, Massachusetts Department of Public Works, spoke on the 1979 Transportation Act providing for highways, mass transit and highway safety. The meeting was a luncheon held at Nick's Restaurant. Attendance 79. This was also an official meeting of the BSCE Section, ASCE.

March 22, 1979 — Future Plans for the MBTA. Mr. Robert L. Foster, Chairman, MBTA, spoke on his thoughts about the present state of the MBTA and his five priorities for the coming year: 1) vehicle maintenance and reliability; 2) budget control and improved productivity; 3) market strategies and increased revenues; 4) communication; 5) construction management and increased accountability. This meeting was a dinner at Nick's Restaurant. Attendance 63.

This March 22, 1979 meeting was the Annual Meeting of the Transportation Group. Nominations and elections were held and the following were elected as officers for 1979-1980:

Rocco A. Mancini	Charman
Edmund J. Condon	Vice Chairman
Robert A. Snowber	Clerk
Thomas F. Humphry	Member
Paul A. Levy	Member
Martin Weiss	Member
Marvin W. Miller	Representative to the Joint Regional Transportation Committee, Boston Region
A. Russell Barnes, Jr.	Past Chairman

Meetings of the Executive Committee were held on April 21, 1978, June 23, 1978, September 26, 1978, November 9, 1978 and January 18, 1979.

Respectfully submitted,
Edmund J. Condon, Clerk

BOSTON SOCIETY OF CIVIL ENGINEERS SECTION, ASCE

Committee Chairmen, 1979-1980

Committee	*Chairman*
ACTION PROGRAM - PROFESSIONAL PRACTICE	Domenic E. D'Eramo
ADVERTISING	John P. Hurney
ANNUAL MEETING	Edward B. Kinner
AUDITING	Robert L. Meserve
AWARDS	Paul J. Trudeau
CONSTITUTION AND BYLAWS	Saul Namyet
THOMAS R. CAMP FUND	Benjamin J. Fehan
CONTINUING EDUCATION	Ronald E. Sharpin
DISADVANTAGED YOUTH	Donald T. Goldberg
EMPLOYMENT CONDITIONS	
JOHN R. FREEMAN FUND	Lee M.G. Wolman
HISTORY AND HERITAGE	H. Hobart Holly
INVESTMENT	Norman W. Bennett
KEY MAN	Frank J. Cullatti
MEMBERSHIP	Richard M. Simon
MONTHLY LUNCHEON SERIES	Brian R. Hogan
OPERATIONS MANUAL	Edward B. Kinner
PROGRAM	Edward B. Kinner
PUBLIC RELATIONS	
PUBLICATIONS	Frank E. Perkins
SOCIAL AFFAIRS COMMITTEE	Robert A. Snowber
STUDENT CHAPTER	Roger F. Gardner

Division Chairmen

Division	*Chairman*
ADMINISTRATIVE DIVISION	Stanley C. Rossier
GENERAL TASKS DIVISION	Robert L. Meserve
PROFESSIONAL AND SOCIETY AFFAIRS DIVISION	Paul J. Trudeau
TECHNICAL DIVISION	Peter K. Taylor
LECTURE SERIES	Edward B. Kinner

SPRING 1979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AMERICAN
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