US Army Corps
of Engineers ®

Water Resources: Hydraulics and Hydrology

Interview with

Vernon K. Hagen

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This manuscript is an edited version of an oral history interview conducted by John T. Greenwood in Springfield, Virginia, on 6 and 15 June and 23 and 25 July 1991. The original tapes and unedited transcript are in the Research Collections, Office of History, Headquarters, U.S. Army Corps of Engineers, Alexandria, Virginia.

Preface

The United States Army Corps of Engineers significantly contributed to hydraulic and hydrologic engineering over the last two hundred years. Exploiting theory, innovation, and mechanical ingenuity, Corps civilian and military engineers studied the behavior of rivers and the motion of water. They investigated hundreds of streams in the United States, many more than once, collecting data on the physical, chemical, and biological characteristics of rivers; regional precipitation; and local runoff. Their work vastly improved the nation's ability to predict floods and to take preventive actions

Hydrology is the science that deals with the occurrence and circulation of water on the earth and in its atmosphere. However, most of its advances have resulted from engineering work, not laboratory research, and engineers have largely determined the present shape of the discipline. As hydrology evolved from a fundamentally empirical discipline to one embracing scientific rationalism and theory, hydrologists faced the problem of reconciling science with political and economic reality. Political and engineering solutions often conflicted in designing hydraulic structures, and satisfying policymakers while adhering to professional standards could severely challenge the engineering community. Vernon Hagen demonstrates that the Corps of Engineers was hardly immune to these professional trials.

This interview is one of several being produced in a special series covering engineers who shaped the Corps' hydrology and hydraulics program. Understanding the experiences, contributions, and thoughts of these individuals illuminates the past and provides guidance for the future. We commend this interview to all those interested in the development of twentieth century research in river hydraulics and hydrology.

Earl E. Eiker, P.E.
Chief, Hydraulics and Hydrology

Paul K. Walker
Chief, Office of History

Interviewer

Dr. John T. Greenwood was the Chief of the Historical Division and the Office of History, Headquarters, US Army Corps of Engineers, from February 1978 to November 1988. He is now the Director of Field and International Programs for the US Army Center of Military History in Washington, DC. He holds a Ph.D. in military history from Kansas State University, Manhattan.

Acknowledgments

Dr. Martin A. Reuss is the project chairman for the Hydraulics and Hydrology series of interviews. Dr. Barry W. Fowle has formatted and helped edit the manuscripts.

Contents

Vernon K. Hagen

Vernon K. Hagen was born on 3 September 1926 in Roseau, Minnesota. He went to high school in Cando, North Dakota, served in the Army in 19451946, and in 195 1 received a bachelor of science in engineering from Montana State University.

In the summers of 1949 and 1950, Hagen worked as an engineering aide with the United States Bureau of Reclamation. Upon graduation from Montana State, he continued as a full-time employee with the Bureau, serving in the land acquisition and hydrology sections of the Bureau's Billings, Montana, office. There he plotted the land areas to be acquired in fee or easement and wrote legal descriptions of the real estate. He also performed surveys, measured stream flows, and participated in hydrologic engineering studies for irrigation and hydropower development.

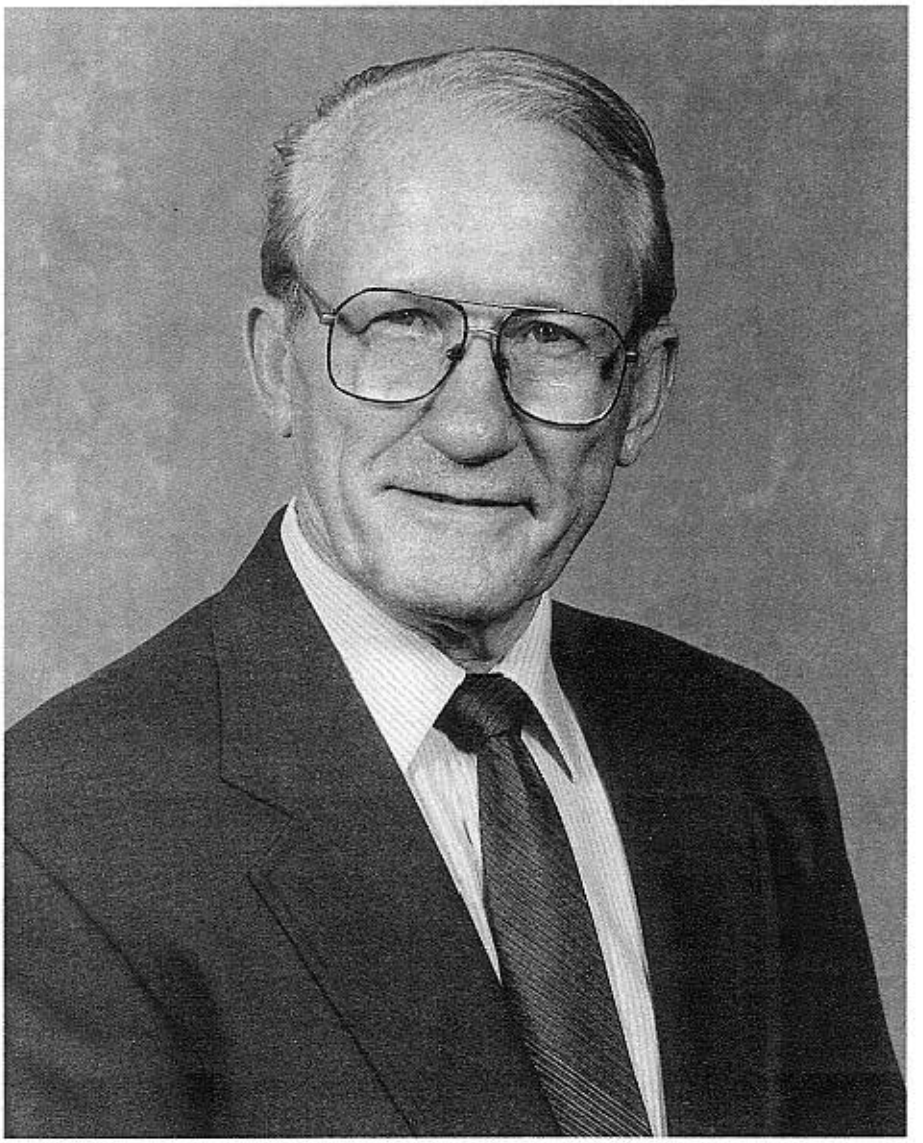
In 1953, Hagen joined the Corps of Engineers and worked in the hydrology sections at Fort Peck, Montana (Fort Peck Dam), and Riverdale, North Dakota (Garrison Dam). In these positions, he continued to develop his skills in hydrologic engineering studies, now expanded to include questions dealing with local flood control and multipurpose reservoir operations. In April 1956 Hagen was promoted to a GS-11 civil engineer, and he transferred to the planning and reports section at Riverdale. His responsibilities grew to encompass the coordination of planning for water resource projects, evaluating the economics of potential projects, and determining cost sharing. In the summer of 1957 Hagen joined the hydraulic design section at Riverdale and conducted hydraulic design studies on spillways, sluice and tainter gates, stilling basins, intakes, channels, pumping stations, drainage facilities, and hydroelectric power plants.

In September 1958 Hagen came to Washington, D.C., and began working as a hydraulic engineer in the hydrologic engineering section in the civil works directorate of the Office of the Chief of Engineers. His major responsibility was to review technical reports prepared by field offices. Arriving in Washington as a GS-12 engineer, Hagen rapidly earned promotion. By August 1961 he was a GS-13 engineer with additional responsibilities. He helped in the development of the Corps' new floodplain management program, served on various interagency committees and work groups, and participated in training sessions. He received a promotion and became chief of the section in April 1967. In that capacity, Hagen oversaw the development of technical guidance to the Corps on hydrologic engineering matters.

In September 1971, Hagen was promoted to GS-15 and became chief of the newly formed hydrologic engineering branch. He remained in that position until 1975, when his branch was consolidated with the hydraulic design branch. Jacob H. Douma headed this consolidated hydraulic and hydrology branch but gave Hagen complete authority in matters dealing with hydrologic engineering. When Douma retired in 1979, Hagen became the new branch chief. He retired from the position in August 1985.

Retired from the Corps, Hagen continued his professional involvement. In 1987, he joined Dewberry and Davis, a Northern Virginia engineering firm, as a senior water resources engineer. During his professional career, Hagen also authored numerous papers and was a member of such committees as the Interagency Advisory Committee on Water Data, the U.S. National Comtnittee on Scientific Hydrology, and committees on flood control and surface water hydrology of the America Society of Civil Engineers.

Hagen and his wife, Jessie, have two children. Their daughter is an accountant, and their son is a high school principal.



VERNON K. HAGEN

Interview with

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Early Years

Q: As I explained, I'm going to start a series of questions starting from your childhood and try to take you through your whole career. That is just my approach. Do not just stop an answer, just continue and say whatever you want to say, whatever thoughts you might have.

Can you tell me a little about your family background and your childhood?

A: Well, I was born in Roseau, Minnesota in a small northern community in Minnesota and my family--[there were] three children in the family--myself and brother and a sister. About the time I was four years old we moved to North Dakota to a small town named Cando, North Dakota. Then, after graduating from high school, my family moved to Bozeman, Montana where I attended one quarter of college before I was drafted in the Army. I spent just slightly less than two years in the Army and after that went to school at Montana State University. I graduated there in 195 1.

Q: Okay. Let me take you back to your high school for a minute. Were there any teachers that you had that particularly influenced your decision to go into engineering?

A: Well, in those days we didn't really get much information on what engineering was all about, really, in high school. In the high school I went to you got mathematics, and I was interested in math and science more than I was some of the other courses like English and biology, for example. But I really didn't have a good comprehension of what the various types of engineering were and what each one of them did. I knew that you built bridges and all that kind of stuff and houses and large buildings and that sort of thing in civil engineering, but that is about all I knew about it.

I knew there was such a thing as chemical engineering and mechanical engineering and electrical engineering, but I really didn't have a good fix on which--I thought I would like

to be in engineering, but I didn't know just what field of engineering even after I started college. After I got out of the Army, I enrolled in electrical engineering because I had been a radar repairman while I was in the service. I went to service school and learned how to be a radar repairman. So with that electrical background--electronics background--why I thought maybe electrical engineering would be the right field for me but after a year or so of that I decided that wasn't right. So I went into--moved over to civil engineering.

The Army and Montana State University

Q: You were drafted into the Army after high school?

A: Right.

Q: So you were in from January 1945 until August 1946. Were you in a Signal Corps unit?

A: No. Well, I first went in the infantry. I went through an infantry basic and some advanced infantry training. Then I got sent over to Hawaii. Actually we were en route to Okinawa as replacements for the infantry that were going to go in on Japan when they attacked Japan.

About that time marry S] Truman decided that he was going to drop the atomic bomb, so we didn't even go to Okinawa. They dropped us off in Hawaii. A couple of months later they dropped the bomb on Japan. Otherwise I would have probably been in there on an assault ship trying to get into Japan.

Q: Which would not have been happy for a lot of people.

A: Right, that's for sure.

Q: When you decided to go to Montana State, was that because your family was in Montana now?

A: Yes, that's true.

Q: A lot of the people I've talked to who became civil engineers in the '50s, credited their ability to become engineers to the GI bill. Did you go to college on that basis, too?

A: Right, that's true. After I got out of the service all of my work--until I graduated--I got on the GI bill.

Q: Now you started in electrical and you switched after a year. What inspired you to go into civil?

A: Well, I learned more about what the various types of engineering did, and I felt that I was more interested in what civil had to offer. I had a professor in charge of civil engineering, Dr. [Eldon] Dodge, who pointed out that he had a series of seminars that all of the students had to take which he talked about professions and just a practical lecture. There was no course work other than just coming and listening to what he had to say about how to go about dealing with your profession and deciding on what you want to do, and things like that.

He pointed out that a lot of graduating engineers actually didn't work in the field they got their degree in. They would change their mind after they had graduated from college and because of opportunities or other reasons they would work in a different area then they actually got their bachelors degree in. Or they would go on and take advanced degrees in some other type of engineering.

That was really one of the most beneficial courses that I think I had in the whole school--listening to him talk about how to find a job and where to work if you were a civil engineer. "Be careful that you don't get into an organization that is run by lawyers and the engineers are in the back room some place. Be sure that in the organization that the engineer's role is a prominent role." All that type of thing that you didn't get anywhere else because he had been in private practice before he became a professor. So he had a lot of background in that area, and he could provide a lot of good guidance. It got a lot of us started off in a good direction I think.

Q: So you had a lot of practical experience from him, where he had been and the same problems and that was really critical. Did you find that a lot of your professors had never been out consulting or working for architect and engineering firms?

A: Well, the majority of them had not been. We had the head of the department and then there was another one that came in while I was there who was a surveying instructor, who came from private industry. He had a lot of practical experience that he brought to the classroom. He taught courses on construction, which was really his course. The construction industry thought that his students were really great because he gave them so

much practical background on the construction work that they were far better than the students from some other school that didn't have that kind of practical knowledge and the experience of the instructor's life.

Hydrology and Hydraulic Engineering

Q: Why did you become interested in hydrology and hydraulic engineering?

A: Well, it [was] my first exposure to working with the government actually. I had odd jobs in high school and so forth, working on a farm, and all that kind of stuff. But when I was going to college my father was a heavy equipment operator and he worked for the Bureau of Reclamation [BuRec]. So he got me connected with the engineering people there, and I was able to get a couple [of] summer jobs working in the soils area.

So I worked in the soils area. Jobs were tough to get when I graduated, to tell you the truth The Bureau of Reclamation, since I had been working for them for two summers, they just assumed I was going to come to work for them after I graduated. They didn't even come after me or anything. I really had to take off from school to go and find out if I could go to work for them. They had never really even taken me off their rolls. I was still one of their employees, which really was to my advantage when it come to retirement because I got extra credit. But I was just on leave without pay when I was going to school, after the first day I started working for them.

But, anyway, they had a few opportunities, while limited opportunities you might say, where I could work when I got through school. There weren't very many other offers around. I had a chance to go to work for Boeing, but I didn't think that I'd want to be in the aeronautics type design.

So I took the job with the [Bureau] and just happened that the job in hydrology and hydraulics sounded more interesting than the other jobs. And after I started work from there I really enjoyed it.

Q: So you didn't have any course training at all beyond the basic BSCE [Bachelor of Science Civil Engineering] work in hydraulics?

A: No. Well, you mean to have the normal courses. This professor that was in charge of civil engineering taught a course on hydrology which was practically non-existent at that time in most schools. But he had even written a book which was in draft form that didn't get published because about the time he was ready to publish another couple of them came

out so he just decided not to publish his.

But he gave us a lot of good information on hydrology and we learned a lot about what it was--I knew what hydrology was all about because of that course. So I knew enough about it so that I felt at home working in there.

Q: Now who was your professor there that taught that?

A: His name was Eldon Dodge. He was the head of the Civil Engineering Department.

Q: So he's the same person who gave you the introduction.

A: Yes. He was a tough guy, I'll tell you, but he taught us a lot.

Q: Well, like you said, there certainly were at that time very few courses and very few people who specialized in that. Was he trained by any of the leading American hydrologists or hydraulic engineers, do you know?

A: I'm not sure--he worked in Wisconsin for a hydraulics firm. So he apparently got his hydrology and hydraulics background from that firm that he worked with. I don't remember the name of it.

Q: But he didn't come from CalTech or MIT or Iowa?

A: No, U. of Wisconsin.

Q: With the BuRec, what projects did you work on?

A: Well, let's see--Yellowtail Dam. I worked on some projects that never got built. A couple of dams on the Powder River, Moorehead Dam and a couple of others that they had proposed but never did get constructed. Things like power studies on Yellowtail Dam. Trying to decide on what was the proper amount of power to put in the project and all. Those were some of those long, tedious type jobs that don't take near that much time anymore.

Q: Now is that where the computers today would do a lot of your calculations?

A: The computers today make that very easy. The sad part about those old computations is you didn't learn anything when you were doing them. You would sit there day after day after day working on the same kind of a problem, doing the same numbers over--number crunching over and over--and you weren't learning anything. It was not a very good experience except that since there weren't a lot of jobs around there anyway, you couldn't be too particular about where you worked.

Q: You had to put bread on the table.

A: Yes.

Q: What did you use to do your calculations? Did you just use a pencil and paper, a slide rule, the basic calculators?

A: We had the electronic desk calculators. Frieden was, I think, one of them. But, you know, there is an interesting thing about that. I moved to Fort Peck after I worked for the Bureau of Reclamation for a while. But there was one of the fellows there that used one of these hand-cranked computers. He wouldn't use the electric operated computers. He would punch in his numbers and turn the crank and get the answers and he just wouldn't use anything else.

Q: He didn't trust the electronics?

A: I guess not. I don't know, I never could figure out why he wouldn't use the other calculators.

Q: Were there any people at the BuRec where you were working who particularly influenced your focus in hydrology or for you to go into it. ? Or was it just the work, you liked the work?

A: Well, I just liked the work and the people were very interesting, too. I had a good boss. I worked in a district office in Billings, Montana, and they also had a regional office there at the same time. The fellow in charge of the regional was named Phil Gibbs. He kept me interested in the field, I'd say, for one thing.

Q: What is always interesting to me are the personal relationships you develop with people and how they can shape your career as far as what you study and your interest in subjects. Was Mr. Gibbs in that category?

A: He and my immediate supervisor, Ed Hower, he was very supportive. Actually, he didn't have the technical capabilities that Phil Gibbs had. But he was a good manager and he tried to make opportunities available for us when he could, and to make our jobs interesting. We used to get to go on a lot of field trips and do a lot of visiting with people, ranchers and so forth. Going out and looking at irrigation projects and checking where water was being diverted and that type of thing.

We'd go up in the mountains and take pack animals and horses and go up there and spend a week or two. About all we'd eat were trout which we caught fly fishing. We'd do some surveying while we were up there and stream gauging, and things like that. So it was a pretty interesting job.

Q: Sounds like a lot of fun. You were doing your job and having a vacation at the same time.

A: Just about it.

Backwater Studies

Q: So those were the field investigations. You just took those observations, or the data you collected up there, and you'd bring it back and make your reports on that basis?

A: Right. We'd use that data to do the computations. We'd have to do backwater studies, and we needed cross sections of the channel and we needed to know what kind of flow, we'd get rating curves for the channels, what to plot, stage vs. discharge. We'd do that with these stream gauge measurements. We'd need profiles of the stream bottom to know what the slope of the stream was and that type of thing.

Q: Now that's how you figured out the volume that flowed through the area and the sedimentation and all that?

A: Well, that's part of the process--you use all that various data you get to help you make the different types of hydrology and hydraulics computations.

Q: You've mentioned backwater studies several times, would you want to explain what they are.

A: Well, a backwater study is trying to find out what the water surface profile looks like for various discharges. What you do is you start with an estimated elevation at a lower cross section. Take cross sections out of the stream so that you know what the shape of the channel and the overbank area look like. Then you start with the water surface down at the lower reach, and you step- by-step you go from one cross section to the next.

As you move upstream the first couple of cross sections probably won't be too accurate unless your initial water surface was real accurate. But as you move upstream you'd become more and more accurate. It dampens out the poorer accuracy as you start off and so that you end up with a good water surface profile upstream. For example, if you want it in the flood insurance program, which I'm working with now, you need to know what area is covered by the 100-year flood.

First of all, you have to know what the water surface profile is for the 100-year flood. Then you take that elevation horizontally from the stream until you reach the ground at that same elevation, and that's the limit of the flooding. Then you'd draw the outline of all that area between the cross sections. Then whatever is in that area is considered the 100-year floodplain.

The flood insurance people require communities involved to force the residents to prohibit building in the floodplain and other agencies and other programs force people to buy flood insurance. Mortgage people say if you're going to get a mortgage from us for you to live in the floodplain, you're going to buy flood insurance. So that's part of the program. But that is a primary use for backwater studies.

Then another thing you use those for is to get what I called rating curves before. You draw a curve that shows elevation on one limb and discharge on the other. You'd get a curve so that you can use that curve to estimate other elevations for other discharges than the known ones. You need that downstream from dams to compute your hydraulics to design your outlet works and to decide on how much hydropower you can get out of the dam.

Hydropower is based on the volume of water as well as the head you have on it--the head downstream and upstream. They are the primary two things that decide on how much power you get out of dams. You need that backwater relationship so that you establish the tailwater elevation and the headwater elevation, that difference in elevation at the same time gives you the total head that you use in your computations. But, anyway, those are

uses for backwater.

Another thing that backwater profiles give you. In designing levees you need to know what the top of the levee should look like. You use that water surface or whatever design flood to decide on the top of the levee. You put freeboard above the water surface so that waves won't go over.

Q: Now you were working in the upper Missouri area at that time.

A: Right.

Benefit/Cost Ratios

Q: The early '50s was before they really had all the big main stem dams in up there. So you had a lot of flood calculations to do then?

A: Right. Well, I first worked for the Bureau for a little while. Of course, the Bureau doesn't do flood calculations. When the Bureau of Reclamations builds a dam and it has flood control storage, they go to the Corps of Engineers to find out what the benefits are from whatever storage they can make available for flood control.

So they don't actually do the flood computations in the Bureau of Reclamation. They have to go to the Corps. The Corps has responsibility for flood control. So they go to the Corps to get that. Likewise, if the Corps has any irrigation in one of the projects that they were building, the Bureau of Reclamation would take care of deciding how much benefits there were connected with it, who got it and all that sort of stuff.

Q: Now that's a particularly significant subject isn't it--the whole area of benefit/cost (B/C) ratios?

A: Oh yes. It has even become more and more of a concern to the Executive Branch of the government and to the Legislative Branch, too. They want to be sure that the federal funds we invest in water resources have a pretty good chance of providing equal or more benefit. Otherwise they don't want to invest the money. They do benefit/cost analysis on almost everything. Not just water resources but all kinds of things, they try to figure out whether they're going to get equal returns from the money they invest.

Q: When you first were with the Bureau and the Corps, benefit/cost was significantly different than it is now, wasn't it?

A: Right. Now they've made a lot of sophisticated changes in benefit/cost analysis. Whether they're getting any better at answers or not is maybe questionable but at least it looks better. The sophistication makes it appear like we are getting better answers.

Q: But as far as I understand it, isn't it mostly to tighten up, to make fewer projects available by making many more criteria?

A: Different people have different motivations for it. But obviously a Congressman who has a potential project in his backyard, he isn't really so concerned about the benefit/cost ratio as his colleague is in another part of the country who doesn't want to put out funds for that guy's area unless he's dang sure that it is a good investment. So, it depends on what seat you're in whether you're concerned about it or not.

But, anyway, the whole idea was when they went through many of these Congressional committees and inter-agency committees to come up with ways of doing benefit/cost analysis. They wanted to be consistent. The big problem was that everybody was doing it different. They wanted to have a common approach to establishing the adequacy of water resource projects.

And, of course, they didn't. They don't just use economics in deciding on whether a project is worthwhile or not. They talk about maximum net economic benefits. Then they talk about maximum net benefits. There is a difference between the two of them because it's just hard to quantify the intangible benefits like preventing loss of life or reducing a risk to the people downstream, inconvenience, reducing inconvenience, and all that kind of stuff. It's hard to put a dollar value on it.

When you're doing one of these analyses you have a hard time explaining why this project is really better than what the benefit/cost ratio says on it. You have to do it in words, it's hard to do it in dollars and many people have attempted to do it. It's pretty hard to convince anybody else that your computations are worth while.

Q: Isn't that one of the problems that the Corps ran into with recreation--how do you compute the benefit of recreation from all these multiple-purpose developments?

A: Well, they had a hard time doing that but they did get to the point where, after making a lot of surveys and studies that people are using recreational facilities, they were able to

assign what kind of money a person would spend on a day at the lake. They would interview people and say, "What did you come to the lake for?" [Some] said, "I come to fish." They'd say, "Well, how much money do you spend?" [They'd] ask them to fill out a questionnaire and say "How much money did you spend to come here for a day of fishing?"

After interviewing a lot of people, they got a pretty good idea of how much an individual person would invest to spend a day at the lake. Now, if a person is willing to spend that much money to come to this project for two weeks, then that's a benefit to society. If you didn't spend it here, you'd spend it someplace else.

With those kind of surveys and analyses, they were able to say, "Well, we have been keeping track of the people that came there." They got a sample of how many come for fishing, how many come for just an outing for the day, or something like that. With the proper mix why they were able to then say, "Well, 30 percent of the people come here for a picnic, 50 percent of them come to fish, 10 percent just for a boat ride." You know, different things like that.

Then knowing the benefit for each one of these things, they could then come up with a total benefit for the project. But then there are a lot of other complicated things that have to get in there, too. How far away will these people come from? If they've got a lake here and there is no other lake around for 200 miles then they have a draw from a bigger segment than if there was all kinds of lakes and not very many people. So they've got to take all those things into consideration.

Irrigation vs. Flood Control

Q: I know it's a very complex, like you say, sophisticated approach. On the upper Missouri, did you run into any particular problems that you had difficulty coming to conclusions on? I don't mean projects that didn't make it, but engineering problems that you ran into when you were working with BuRec. Problems for which you had difficulty in finding solutions?

A: Well, some of the things that you need to estimate are very difficult when it comes to deciding the operation and the management of the storage you have available in reservoirs. For example, when you're in that part of the country a good share of the runoff that you get comes from snow-melt. Okay, now if you can forecast how much runoff you're going to get, say early in the year in January, you can start filling the reservoirs up or you can capture that snow runoff. If you've got a lot of snow and you know pretty much how

much runoff you're going to get, you can start drawing down your reservoir to prepare it to catch the runoff.

Then, if everything worked perfect you would forecast how much runoff you were going to get, and you'd draw the reservoir down and then the inflow that came in would exactly fill it back up to the top of your irrigation pool by the beginning of the irrigation season, if everything would be hunky dory. But what happens if you make a wrong forecast and you say that there is going to be a lot more water coming off then actually comes off, then you draw down too low and at the beginning of the irrigation season you don't have as much water as you should have.

Where on the other hand if you make a forecast that is too low and you don't draw the reservoir down far enough, then you can't take care of the flood and somebody gets flooded because you didn't have enough storage to control it. So getting the exact balance, forecasting that, is really a tough job. We used to work and work on forecast equations based on what had happened in previous years, and you'd come up with regression equations, taking into account all kinds of things like rainfall and temperature, antecedent runoff, and other pertinent information.

You'd find equations that would maybe hit 95 percent of the time. But then there -would be one year that nothing seemed to work on. It would be way off no matter what you did with the general equation that you were coming up with. I believe, let's see, on the Colorado River I think it was--I'm trying to remember what year it was. I believe it was 1952--no, no, that wasn't it. It was after they had filled up the conservation storage in Glen Canyon. Anyway, it was before I retired. Maybe it was '82, that sounds more like it--maybe '82.

The forecast was way off because what happened is they got a real late snow in the year. It was real late, like a real heavy snow which they hadn't predicted earlier, therefore they hadn't drawn the reservoirs down very much or anywhere near as much as they should have based on this later snow. Then it got real warm right after the snow, and they got a lot of runoff. There was quite a bit of flooding and a lot of damage to some of the Bureau projects from that big flood.

They had a tough time--they were very lucky that they didn't have even more damage because of the fact that they hadn't been able to draw down, or didn't contemplate this, or had no way of forecasting it. There was a lot of criticism about the whole thing on the lower Colorado because there was all kinds of recreational facilities down there along the river, and they were getting much higher releases than they had ever gotten before.

Of course, they had benefitted from many years where they were filling up the reservoirs.

They were big dams and took a lot of water to fill up the conservation storage. So those years that they were filling up the conservation storage, why they never had any floods downstream. Had all kinds of extra storage so they didn't have to worry about floods while they were filling up.

Well, once they got full, why then they had to start doing this annual operation I was talking about. When you do, many people get involved in deciding what the operation of a major reservoir should be because you've got the people that live around the reservoir. They don't want to be flooded by the reservoir being too high.

You've got power interests who don't want any water going out of the project unless it goes through the powerplants because they're afraid of losing money. You've got the irrigation people, they want the storage as full as you can get it so they have lots. While the flood control people want it down as low as they can get it so you have lots of water for flood control. Trying to coordinate all those interests together and get the right mix. . .

The fellow that taught me the most about that was named Emil McLendon, and he was in charge of water control management for the Missouri River Division when they had all those big projects on the Missouri River. He was a very sharp man. But he learned early on in his operation management of those reservoirs. I don't know, maybe he learned it from his boss, too--Tim Wora, who was his previous boss. But they were the first ones that really got involved in that upper Missouri water control management.

They learned early on to get all the interests together in making decisions. Don't try to do it by yourself. Like the Corps people try to make all the decisions and then tell the other people how it is going to be done. Because everybody will be screaming at them.

So what they did, they started off with the idea of having these operational meetings that they would have. They would come up with a preliminary plan for operating the reservoirs. Then at this meeting, why all of the interests from power, irrigation, states, competition among states and all this sort of thing. All the state representatives would be there. They would lay out their preliminary plan for how they were going to operate the reservoir for that next year based on what the pool levels were at that time and what was expected.

If one person, for example, if the fellow from the irrigation interest would argue strongly, "Hey, you're not storing enough water," why immediately the flood control interest would jump up and say, "The hell they're not, they're storing too much or something like that." So they'd get all these people, and they'd usually end up getting their preliminary plan approved because they didn't have to argue with the people that objected to it. The other

people, they argued with each other.

They finally realized the importance of the other guys' point of view, too. When they got in a room, then the irrigation man had to convince the flood control man why his point of view was so important. Anyway, they used to be pretty interesting sessions.

Q: Was that Missouri Valley Basin Association or compact there in the upper Missouri basin?

A: Well, there's an upper Missouri Basin Compact. When they decided on how the storage was going to be distributed and all that, why they had an inter-agency, or inter-state really, agreement, a compact, on who was going to get the storage for irrigation, where it was going to go, especially on irrigation. Well, some of the states didn't benefit much from irrigation because the water was downstream from them, so they didn't get the benefits that some of the states farther on down the river got from the irrigation and power.

Of course, what happened with power, they can run the power back, like to the state of Montana, even though it's made down in South Dakota or in North Dakota, the power can be distributed back into Montana. So they get benefits from the project even though they're upstream from the actual flow of the water. But there are very complex agreements on how to do all these things.

[What] I was talking about was just the Corps of Engineers' management meeting, and it didn't try to change anything in the compacts or anything like that. It just says, "Well, here is how we're going to try to give everybody exactly what is in the compact." But sometimes if you don't--like I was pointing out before-- you can't actually do it exactly as you wanted to do it. So you try to figure out how you can do it, and still give everybody the best deal they can.

An interesting part of it is when you get into one of those tough years when there is a big flood or something like that, some of the Congressmen and Senators are very difficult to deal with. Back in the Corps days when I was involved in some of that stuff, we even had senators from North Dakota tell us, "You're only going to release so much from Garrison Dam and you're not going to fill the reservoir over so high." We'd say, "Now wait a minute, how can we do both?" Or, "We can do either one or the other but we can't do both."

Don't matter what you say or any other person, physical laws just don't allow us to do that. If you've got so much water that you cannot store it in a reservoir, it's got to go downstream. You can't just say we're going to put it in there and squeeze it together. But that's how stern they were and how uncompromising they were--because they had

constituents upstream and constituents downstream and they were telling both of them they were going to take care -of them. That was impossible to do. They really get angry at you because you tell them you couldn't do it.

Q: Politicians are not necessarily good about understanding some of these things, are they?

A: They understood them, they just didn't want to. They wanted to be able to tell their constituents, "We've taken care of your problem," and it's not always possible.

Q: In this particular kind of thing, where you would set out to adjudicate interests basically, what was the balance between rural and urban? Were there any significant conflicts in many of these areas between rural and urban interests, say irrigation versus flood control?

A: Well, you can think of a lot of incidences where rural people benefitted from storage that they didn't pay for. Just to give you an example, there was one small reservoir project in North Dakota that during drought years--it was a flood control project but it had some recreation storage in it--but during drought years they didn't have enough water downstream to water their cattle for some drought years. They had no rights to release water from there--there was no legal claim on the water in the reservoir.

The Corps or the Bureau of Reclamation, or one of the federal agencies like the Corps, would allow some release to go downstream to take care of those domestic needs, not [for] irrigation particularly but just to take care of domestic needs and to keep some fish in the stream and things like that, even though there haven't been any when the project was originally authorized. Nobody, of course, ever really complained about it. But they were getting benefits that they didn't pay for.

If they really wanted those benefits, why they should have been paying something for it. But they weren't willing to pay for the storage to put in the reservoir, but they were willing to collect the benefits from it. So there are a lot of people that want the projects to do things for them, but they don't want to pay for any of it.

I guess the biggest hassle when it comes to irrigation vs. flood control is the fact that you have to get somebody to pay for the irrigation. When it comes to flood control, if it's considered widespread benefits and therefore, unless it's for a particular individual or something like that, why the federal government generally takes over most of the cost, or it used to anyway. Things have changed somewhat. At least they took over the majority of the cost.

So it was a lot easier to get flood control projects than irrigation projects because you didn't have to go out and round up a bunch of irrigators like you have to get irrigators, irrigation districts, and so forth, to repay the costs of the irrigation storage. You don't have to do that with flood control. You just have to come up with a good B/C [benefit/cost] ratio.

So the Department of Interior, in their wisdom, decided that they would use some of their power revenues to help pay for irrigation. That was a big controversy in years gone by when some of the power revenues would be used to help pay for the cost of the irrigation. The way they did that, they had--oh what did they call them, they were area accounts or something like. In a particular part of the country, in all the Bureau of Reclamation projects in that particular area, the benefits from all of those would go into a common pool--or I mean the power, irrigation, and all those things would all go together--to help pay for the projects.

If there didn't happen to be as much irrigation benefits as the cost allocation indicated there should have been, that didn't really make much difference as long as they got enough benefits from all the other purposes, too. So it helped the irrigators get storage for a lot less then they probably would have had to pay otherwise. It helped develop the west, you know, doing that sort of thing.

Q: Oh yes, I guess they're finding out in California now the requirements for them to pay more for the water.

A: Well, then, of course, as time goes on, these water rights situations are really a tough thing out in the west because the western states allocate water and the appropriation, appropriative rights, were first in time you know and get the water. If you had an appropriated right dated way back when, nobody else could get the water you had. The way they used the water early on was kind of frightening too because if you had an appropriated right ...

The problem was people had a right to this water, and they could keep on taking it out of the stream all summer long or all during the irrigation season. Obviously, they weren't running it onto their irrigated lands all the time. It would just run on through their channels and systems on down the river.

But then, with a lot more coordination and cooperation, they got these people to shut down their gates when they weren't using it, so other people would have the water available, so it would stay in the stream. The next guy downstream would get his--who had second

right maybe-- would get his water. It wouldn't just be diverted off, all of the water wouldn't be diverted off--but if a guy was really hard-nosed, under the law he could leave his gate open all the time because he had that right to the water.

But they've been a lot more hard-nosed about it in modifying those laws and so forth to get more equal use of the water. They say that they can use it, and it has to have a beneficial use. But how do you enforce that? Are you sure that he's irrigating or isn't irrigating and all that? The irrigators would go out and shut down one guy's gate for water and open his. They had ditch riders, they called them, who were hired by the irrigation districts who had constantly, all during the irrigation season, go around from one irrigation gate to another to make sure that the proper gates were opened and that nobody had messed around with them because there's a lot of people trying to steal water.

If they were down the list in appropriated rights when they weren't getting any water and other people were, why they would try to go and steal from someone. People would shoot each other and everything else out there when it came to water.

Q: Matters of livelihood are the key. Up in the upper Missouri, did you have a lot of difficulty with water rights?

A: Well, there are state documents listing water rights. Wherever there are appropriated water rights, you have a lot of problems with it, the state does, trying to maintain it. Another thing, when it comes to the water rights that are given for people in a rural area for irrigation, what happens when a community needs water. How do they get it. They go out and buy some of this land that has a water right and then they convert the water to M&I [municipal and industrial] use instead of irrigation use.

So the use of the water gets turned around. A lot of that has happened. A community, for example, could buy land that had an appropriated water right, take that right and use it for M&I, and then sell the land for somebody to do dry farming or development or some other purposes.

Q: But the states were really the ones that control those things, aren't they?

A: The Bureau of Reclamation does handle water rights, too. The Corps of Engineers never gets involved in water rights, never, it was their policy--that's a state problem. But in a lot of the Bureau projects in connection with the irrigation, they actually got a right one way or another, I don't know, it depended on whether there was any rights left or not.

But they actually got rights and sold water. They sold water to people based on their right to the water, and then they would sell it to the various customers.

But the Corps never felt that they owned any of the water. Well, the Bureau didn't either except that they owned the right to it. Once they got an appropriated right, they'd store it in their project and they could sell it to other people like the irrigators and so forth. So it was a little different deal with the Bureau than with the Corps.

The Corps didn't worry about whether it had a right to store the water or not. As long as it was causing a flood! the laws allowed them to store it and reduce the floods. But, anyway, it's a complex subject, I guess, and kind of hard to explain all the weird things that go on.

Q: Well, it certainly is one that is becoming more obvious, especially in a place like California. I guess in places where you have the old Spanish water rights and people have those rights that pre-date the states.

A: Well, the lawyers are fighting all about whether those rights are any good or not and it's like they take away things from the Indians, probably taking away some of these Spanish rights that they had too, a long time ago. It's what is fair, and some places it's a lot fairer than others, I guess.

Q: I think it's something they call situational ethics. You were up in the upper Missouri basin at the time that a lot of the work on the Pick-Sloan Plan was under way. The big main stem dams, starting with the Garrison Dam, at Gavins Point, Fort Randall and all these other ones. How much do you think that has changed that whole area from what you knew when you were growing up there?

A: Well, the biggest thing that I can obviously see is the change in availability of electricity. The REA [Rural Electrification Administration] handling of the electricity, using electricity from all these big projects, to modernize farming. Most of the farmers had [had] their own little power plants. Years ago when I was a kid anybody that had electricity on a farm, they had their own little generators and made their own power. They didn't have any power lines coming out to their house so that they could use electric power for all kinds of things that they do now.

My brother-in-law is a farmer out there, and he uses a tremendous amount of electricity for drying his grain, for all kinds of different things. He has all kinds of electrical equipment that he uses in his farming operation. He wouldn't be able to do that if it

hadn't been for this availability of electricity. So there's a lot of power--power has changed the way the farming **community** lives and operates.

Actually, as far as the irrigation, I don't really see too much of the irrigation part of it where I happen to live. Just that they hadn't received really much irrigation. There are a lot of irrigated farms now, of course, because of the Pick-Sloan Plan. But there has been a big reduction, of course, in floods. That is one of the major contributions is the cutting back on all the flooded areas.

There are still areas up there that are not protected by these large dams, too, like the Red River of the North. There is still a lot of flooding that goes on up there because they don't have any major place to store the water and the land is so flat it just floods everything.

Water Quality

Q: Wasn't that an international problem because you had to deal with Canada on that river?

A: Oh yes, it's a serious problem there--well, one of the things is the water quality, that's a big problem, with irrigation return flows picking up a lot of saline material and other contaminants coming into river. They go into the Red River and the Red River flows north up into Canada with all of these contaminants in it and Canadians scream in horror, "Hey, you're messing up our waterway." They have a lot of problems with trying to take care of that sort of thing.

Q: That's a problem in the big dams up there, too, isn't it. The contaminants come into the pools and settle.

A: Actually, it's not such a big problem with a big dam--the contaminants usually take place when you're getting return water that has gone onto a field and it leaches the salts out of the soil and so forth. They dissolve in the water and then they come back into the return flow channels that take that return flow back to the river and the water that goes back in the river is not anywhere as near as good as the water that came out of it to begin with.

Now they have things in reservoirs to help them avoid that that they didn't have earlier. But they have more of them now. These multi-level withdrawal outlet type things where they can take the water out of the reservoir at different levels. Now the water is the worst at the bottom of the reservoir. That's where a lot of the vegetation decayed and there's a lot of different kinds of chemicals and things that develop down there that are

undesirable.

So what happens is if you build this outlet works that can take water off the middle of the reservoir or near the top of the reservoir, you get a lot more oxygen in it. The big part is the oxygen depletion. What happens if you draw off the bottom of the reservoir [is] you don't have hardly any oxygen in the water and the fish can't survive downstream. If they swim up the river and they get close to a project that is dumping this oxygen-deficient water, then they of course die or go on back downstream. They just can't get up close to the project.

Well, they've come up with different devices to help that situation. They put in mixing gadgets to stir up the water so that they don't get all this stratification of water, you know, the good water on the top. Then, when the temperatures change, the water turns over and what happens is the water on top gets colder and heavier and the whole thing turns over.

You'll find that sometimes in the water supply here it'll have a bad taste to it probably for a little while when the reservoir turns over until it kind of settles out again. That's when all this bad and good water will mix up.

Q: Were these kind of things with reservoirs fully known when you were working up there or is that a result of the hydrologic studies that have been done since?

A: Well, when I first started in the business we didn't even know much about stratification of the reservoirs. We knew a little about it but hadn't had any money to study that sort of thing much. So it wasn't until after they started learning more and more about how water quality is important. As a matter of fact, there used to be some strong arguments.

I remember one time, well after the Clean Water Acts. When you go back to when they first started, let's see, the Water Pollution Control Administration [WPCA] was the first agency I think that handled that sort of thing. They were trying to make other agencies be responsible for water quality and take a real active role in trying to clean up the quality and that sort of thing.

One of the things that the Corps used to have is storage in the reservoir for mitigating water quality damages by discharging flow out of the reservoir. They'd use storage in the reservoir to dilute the contaminated water downstream, and they claimed the benefit for it. Well, they finally decided they [the Corps] couldn't get credit for that kind of a benefit anymore. They said they'd [the Corps] have to clean the water some other way, not use dilution as a solution. One of the arguments, no more dilution as a solution.

I remember even having a big discussion at one of our conferences out in the Pacific Northwest one time. My boss at that time was Al Cochran. He was head of hydrology for many years in OCE [Office, Chief of Engineers] and taught me a lot of the things that I learned and knew about hydrology. But he was real slow to take up this concept of water quality. He didn't really want to get into it. He just seemed like he was very slow to grab on to it.

But, anyway, we were having a big conference up there on a reservoir, and I was concerned about some water quality studies they were doing there. I was telling them, "Well, even though you're contracting out these water quality studies to some experts that are not in the Corps of Engineers, you need to get these computer models, you need to be familiar with them, so you can use them in your reservoir regulation procedures because you are the guys that are responsible for that water quality. So if you don't do a good job on it, why the Corps is going to get a bad name, and you've got to work that into your water quality management."

My boss was sitting there listening to me. He said, "No, no, don't worry about that." I kind of was taken back quite a bit by his attitude on it. The conference went on and on. All of a sudden right in the middle of some other discussion, Al booms out, "Wait a minute." He said, "By god, you do have to do what Hagen said." He says, "I'm wrong, you do have to be responsible for that water quality." It really surprised me that he did that. But he got to thinking about it, and he says, "Hey, we do have to do that." So he made his opinion clear then that we were going to have to be responsible for it.

But it was tough getting people to take on the responsibility of improving the water quality. Actually it was kind of a thankless job. There was not much money for doing it. It was a tough, difficult thing to do. Hard to figure out what to do.

Q: So the hydrologists would have been some of the first people in the Corps' to have greater sensitivity to environmental issues dealing with water?

A: One of the things we found out, too, was in training people to deal with reservoir water quality--now reservoir water quality is the primary thing that we're talking about here. But yet we found that it was easier to take somebody who was a trained hydrology person, we'd like to call them. Practically all the people we had in those days were engineers, not hydrologists per se. A hydrologist doesn't have to have an engineering degree--it can be a degree in science and not engineering.

We usually had engineers as our hydrology people whereas not necessarily the Soil

Conservation Service [SCS] but the USGS [U.S. Geological Survey] would hire hydrologists to work on the scientific aspects of hydrology. We found that it was easier to train somebody who was an expert in hydrology in the water quality aspects than it was to bring in biologists and people who were trained in the water quality of the chemical and biological parts of water quality [and] to teach them the hydrology they needed to know to go with managing the reservoir.

So a lot of the people that were managing the water quality sections or branches in the Corps offices were really first trained in hydrology, although we did bring in a lot of biologists, chemists, and other people, too. But it seemed like they weren't as well equipped to handle the management part of it. They were pretty good on the technical aspects, but they didn't really know how to handle the operational part of it as well. So it usually turned out that the people that were trained in hydrology ended up being in charge of water quality, too.

Q: Now that whole thing was quite a change for the Corps wasn't it?

A: Oh. yes it was. It was a really dramatic change. They were really slow picking up on it and when they finally got going on it, they did a good job. It just took them a while to get going. They were just reluctant to take on the whole concept. You would hear how the Chief of Engineers would get up before the division engineers and tell them, "Yes, we're really going after this water quality and the environmental concerns." But for the action to get down to the working level sometimes it was pretty hard to convince those working level people that they needed to do things like that.

It was typical of a lot of different Corps programs. For example, the Dam Safety Program of non-Federal dams that the Corps got involved in. The President said, "The Corps will go out and examine all these non-Federal dams for safety." But there was a limited amount of money to go with it, the authority to do this and the responsibility to do it.

A lot of the practicing engineers in the Corps were very reluctant to get involved because they knew they weren't going to be able to spend enough money to really find out for sure whether those dams were safe or not. Especially the structural engineers and the soils engineers, too. How do you know what kind of condition that dam is in if you don't go out and do a lot of testing and soil drilling and things like that to find out if there is leakage internally in the project or something.

They hadn't had any experience on these projects. They were going off and taking a quick look at them and deciding whether they were safe or not. So it ended up that the Chief of Engineers had all the people in the office one day and he told them, "Hey, we've got

this program. The President has told us we're going to do it and I'm telling you I'm working for the President." He said, "I'm going to do it, and you're working for me, you're going to do it." It's either do the job or find some other job.

Q: Was that Chief Jack Morris?

A: Well, was it Jack? I don't remember, it might have been Jack. Might have been him.

Q: That sounds like something he'd say.

A: But anyway, it probably was him. Can't remember for sure. But anyway, whoever it was at the time, he really came down hard on the field offices and said, "By god, let's not hear any more of this moaning and groaning and stuff like that. Let's get with the program." So it finally got going. But, there were still a lot of people out there that weren't willing to make any kind of commitments.

We finally got to the point where we didn't really say that any of them were safe. We just wouldn't say they were safe. They were just kind of a no case. If it wasn't unsafe, we didn't say much about them. If we found things that were unsafe, why we would report them. Otherwise we just gave them an informational package on what the dam was all about and what it did and not say anything regarding safety.

Al Cochran and Gail Hathaway

Q: Several minutes ago you talked about Al Cochran and what he meant to you. Wasn't he was one of the first people to get hydrology accepted at OCE?

A: He wasn't the father of hydrology. Gail Hathaway was the father. Al was the guy that went out and sold a lot of it after Gail had first got it going good. But he worked for Gail. He and Frank Snyder were the two of Gail's disciples I guess--hydrology disciples or whatever you call them. They were the ones that really sold the program to the Corps and to everybody else. But Gail was the one that started it off. I never worked for him but I knew the man.

When I went to OCE, Al was in charge and Gail was working for the chief as a special assistant. But Gail really had a lot of respect from all the people all over the world for his ability. Well, he was head of the ASCE [American Society of Civil Engineers] one year

and, he went over and made some talks on high dams and stuff like that.

Q: Yes, he was a leading person certainly in the Corps and the whole area of civil engineering.

A: I guess from my own personal experience, why Frank Snyder and Al were the two most important people in my career as far as training me and giving me the ideas that I have and so forth. Frank was particularly important in my career because when I was first in OCE, whenever I had a question I could go and ask him a question on almost anything and he knew the answer to it. It didn't make any difference what it was. If he didn't know the answer, he'd figure it out and get you an answer in a couple of minutes.

Probably from a purely technical standpoint, he was better than Al. But Al was a very domineering type fellow who could get things done by going out there and beating on the table and arguing. Well, he was knowledgeable, too, but I don't think he quite had the technical wherewithal that Frank had. But Frank got a lot of recognition for his capabilities all over the world.

Well, you know Gail and Al and Frank are all in the distinguished gallery up there in OCE and Jake [Douma] , too. So they were recognized for their capabilities all right.

Fort Peck District, 1953

Q: When you left the BuRec and went to Garrison District, was that just a promotion or did you want to change what you were doing?

A: Well, I wanted to change what I was doing. What happened was I was working in the district office there, and they had a RIF [reduction-in-force]. As I was telling you, these were tough times. They shut down that office pretty much--I mean to a non-engineering office, it was more of an operating office. They moved me over--because I was a veteran I was able to maintain the same grade--but they moved me over into a land acquisition unit.

Well, I didn't stay there too long before I got this job at Fort Peck. I didn't like that kind of work and I wanted to get back into hydrology and hydraulics and a job came open in Fort Peck and so I applied for that. So I went to Fort Peck.

Q: What did you do at Fort Peck when you went there in about 1952?

A: '53.

Q: So you went to Fort Peck Dam or was it Fort Peck District, was that still in existence?

A: There was a Fort Peck District at that time. When I was there they shut down the district, and it no longer became a district. They moved most of us over to Garrison and a few of the people they maintained there for operations purposes.

At that time, of course, Fort Peck was completed and we were a Fort Peck District but we weren't really working on Fort Peck other than operating it. The projects that we worked on were other places and were levees and small dams. We did some work on Garrison, too. But there was a Garrison District, too, at the same time, and so we didn't really do much work on Garrison. A lot of the work on Garrison had already been done.

Q: It was in the middle of construction then, wasn't it?

A: It was in construction. So all the design work and that sort of thing had been done.

Q: Well, Fort Peck has a monumental place in the Corps history for a lot of reasons. One of them being it's famous slide in the late 1930s.

A: Oh yes.

Q: It's a huge project, isn't it?

A: Yes, it's a big project, but when I was there, there wasn't a big staff there because it had all been completed and it was really just kind of an operational district, even at that time. There were not very many studies being conducted from that area. There were a few but not very many. Gordon Lightfoot was the chief of engineering at that time there. He left there. He came to Washington to work with AID [Agency for International Development] program, I think.

Q: A-I-D?

A: Yes. But he was a real top notch engineer, Gordon Lightfoot. He was one of the better

engineers that I've seen in charge. I had some good chiefs of engineering along the way, too. Some really good ones.

Q: When you were in positions like those at Fort Peck, did you have much to do with the people from Missouri River Division?

A: Well, they were, of course, our supervisors in a way. Not day-to-day supervisors, but they had to review everything we did. Once in a while, they would come out there and go over the studies we were doing and tell us whether they thought we were going in the right direction and that sort of thing. McLendon used to come out there once in a while and give us direction.

At Fort Peck, well, I really didn't get as much at Fort Peck as I did at Garrison. I had more dealings with the division at Garrison then we did in Fort Peck. But in Fort Peck--well, I was only there for about a year. I worked in the Hydrology Department there and a good share of my time was spent on the Sun River Project, a levee project up in Great Falls which was an interesting project from a standpoint that the engineering work I did on that I use to help get my professional registration at that time in Montana.

You had to submit evidence of actual engineering work on a particular project of some sort in order to get registered. You don't have to do that anymore. But in those days that was part of the requirement. So I used the studies I had done on Sun River to help get registered.

Q: That sounds like a healthy idea, actually, doesn't it?

A: Well, it is one, but they just don't require that anymore. It was more tough really, I think, at that time to get registered in Montana than it is now because of the fact that you may not have had very many significant design jobs in the first four years you work because you may be working as an underling for somebody else on most everything and not have something you can point to and say, "Hey this is my original work, and I was the guy that was responsible for getting this completed and so forth."

Fortunately I was able to do that on this Great Falls project. The interesting part of it was that we were designing this--well, most of the time we tried to design levees to take care of the standard project flood. I don't know if you're familiar with various types of floods and so forth, but they are a pretty good size flood normally.

At Great Falls the Bureau of Reclamation had made some proposals to protect Great Falls

from the Sun River by headwater dams, you know adding to their Gibson Darn way up in the mountains and so forth. Of course, we in the Corps argued that they were only controlling a small part of the drainage area and that wouldn't do very much for flood control.

But history made it look good for the Bureau because the major floods had happened up in the mountains. They hadn't really had a major storm over this big drainage basin between Gibson Dam and Great Falls. Maximum flow at Great Falls at the time I was working at it was about 17,000 cfs [cubic feet per second]. I worked on the standard project flood with some guidance from McLendon on the rainfall.

I worked up that standard project flood. I come up with a value of like 60,000 cfs, or something like that. So much more than they had ever had there that I thought, "Boy, I'm going to have a heck of a time selling this to anybody that would be willing to design for that big of a flood because traditionally if you had something that is quite a bit bigger than the people had seen before, you have a hard time selling it."

But my boss has accepted everything that I had done, and McLendon accepted it [and it] went right on through and got approved. They didn't build at that time, but many years later the Omaha District was handling that project up there and they had a big storm in '62, I think, or something like that, and it almost reached the standard project flood that I had computed back in those days. Just to show that just because you haven't had some doesn't mean you're not going to get it. The big thing about hydrology is trying to convince people that a potential for floods is there in a lot of cases, even though you haven't experienced it.

The Theory of Hydrology

Q: A lot of what the hydrologist does is basically theoretical then.

A: Oh yes.

Q: It's hard to sell people on theory, isn't it?

A: Oh, very difficult. Well, you take this big drainage area like we had, a pretty big drainage area above Great Falls there. We knew there was a lot of potential for storms up in that area. We knew where storms had occurred all around it, and we knew the size of those

storms. How much rain had occurred in the time, the distribution of the rain, and so forth. If you move one of those storms over the basin, you can see that the potential is great there.

But because that storm hasn't actually happened over their basin, they're very difficult to convince. But you can show them on paper pretty easily. "Hey look [at] it. All you've got to do is move this storm over here a little bit and here is what is going to happen." But they say, "Oh well, I've lived here for 50 years and I've never seen anything like that. So you must be really imagining things." So it's a tough job trying to sell people on the risk they face in flooding if they haven't experienced it.

Q: So in hydrology you use an awful lot of meteorological data?

A: Oh yes.

Q: There is a lot of that in your computations.

A: One of the things that the Corps did early on, back in Gail Hathaway's days, was to fund a big contingent of the National Weather Service to do studies for the Corps. Practically everything they did was in connection with some Corps project because the Corps was paying all their salary. To this day, they still pay for a good portion of those people's salaries.

While they don't dictate exactly what they do or how they do it they just dictate that they have to work on Corps projects and do the work for the Corps. One of the reasons [was] that Gail felt very strong about having a component outside of the Corps who really had no interest in pushing a project or not pushing a project. Where they're completely unbiased, you might say, in doing a meteorological study.

Whereas, if you are a member of the Corps of Engineers then you may be influenced in your studies by your boss who wants to have a low answer or a high answer or whatever he wants to have. He may put a lot of pressure on you and even though you may not think that you're complying with that pressure you may just say, "Well, I'm really going to try to get the smallest answer I could to keep peace in the family," or something like that.

I've run into situations like that, too, when we were in Garrison we had a chief of engineering who didn't like the answer for a standard project flood that he got out of hydrology because there was so much political pressure on reducing costs in this one project. He told my boss at that time to go back and redo his studies because he had made

a mistake and it was too high.

Well, there was another example of where shortly after the study had been done they had a big flood and a big flow very close to what the standard project flood had been estimated to be. So Dick Fields said, "Hey, I guess you're right, go back and change it." But if that flood hadn't come along, why his trying to satisfy the political concerns would have had a big impact on the design of the project. It's tough.

The funds are limited and everything--what do you do? Do you still do all of your hydrology on the basis of no concern about what it cost to take care of it or do you try to squeeze it as much as you can to make the hydrology fit the project that the people want and that sort of thing. There is a lot of politics involved. Of course, most of the people that I've dealt with in hydrology were on a high professional level [and] felt very strong about being unbiased about their decisions and try to keep answers reasonable and not actually fudge the answers to get something that a top official might want.

Q: That's in the area of ethics that has become much more important now for professional engineers.

A: It's an important one of engineering--you know it's tougher in an area like hydrology than in something like structural engineering where a lot of the stuff is pretty straight forward. It's all well documented and everybody knows what the right things you're suppose to put in there and so they can't ask you to fudge any.

But when it comes to hydrology, suppose the project doesn't quite make the benefit/cost ratio and there is a lot of pressure to have that project have a B/C ratio of 1.0. The planner comes over to you and says, "Hey, we can't make it on this project and the Congressman wants it real bad. The district engineer called and we're going to build him a project. What can you do with that frequency curve?"

Well, all you got to do is move the line a little bit and the project is justified, you know. It doesn't take much to move that line. But we'd say, "Well, grant it, it's possible that it could be on that line but how about your damage analysis. You know, how good are they? Are they so accurate that you couldn't change them to get your justified project ..." "Well, no they're accurate." Well, they're no more accurate then the frequency curve. Now do you fudge it a little bit until you get the project?

You know for certain that the answer you've got isn't proof perfect, you can't prove that it's perfect, but you still have a tough time trying to say, "Well, should that thing be

changed at all or not." Some people, if you give them enough pressure, might change it a little bit. Others--they wouldn't change it no matter what. They say, "This is my best answer and I'm not going to mess with it at all."

But you have to realize, I think, in some areas in hydrology that there is enough margin there that if you just made it a little bit of a change that you're really not going to hurt anything. You're not going to be misrepresenting the facts or anything like that and to be so hard-nosed that you could never move that line one way or the other because you don't have any way of proving it. Your answer is absolute. If it's for the good of the country or something, maybe you can move it over.

Q: When you get into that kind of theoretical area, though, that's a problem, isn't it?

A: It's a real difficult problem. How much can you move it though. If somebody says, "Move it a long ways." Oh hell no, I'd never do that, that's obviously wrong. But when you're right on the verge, right in the middle there where a decision to go one way or the other could make or break a project, what are you going to do. You're going to get a lot of pressure and a lot of times the people will say, "Well, there are other benefits that make up for that anyway so why worry about it." That's a part of it.

Al Cochran use to be very adamant about trying to get as much out of a project, in terms of degree of protection, as he could. He really pushed for that; most storage you could get or the highest level of protection in a levee. He'd try to squeeze every bit he could out of it because he always felt that we hadn't experienced enough of the floods yet. There were a lot of them coming that we hadn't seen yet and that it was--well, there were a lot of things that go into the philosophy behind that.

For example, if you build a reservoir, you take a valuable dam site. There are not very many of them, hardly any of them left anymore. But back in those days, when they were building a lot of dams, you've got only one dam site there. If you would optimize the economics of the project and just only put enough storage in there to get a B/C ratio of 1 .O, then what happens is you're really not taking full advantage of the site there.

They may have gotten a lot of room to put in more storage in there that could be used maybe later on, but you're just not sure of what all those future uses might be. While they put in future water supply storage in a lot of projects on the bases that the state would say they needed it in the future. They would put that sort of thing in.

But Al felt that, "Hey, if you spent all the money to build this project, why not put a little more storage in to give you a cushion to be sure." There were a lot of projects where his

concept saved a lot of people's lives probably and a lot of money. The Cherry Creek Dam in Denver is one of them where they got a huge flood after the project had been built for a while.

There were enough benefits from that one flood to more than pay for the project, not to have to worry about any other floods paying for it. So the economics, even though it looks good on paper, why you can't really be sure. Even though what has happened in the past is a pretty good indication of what might happen in the future, we have such a short time span for looking at the past compared to what the future is going to be that we don't have that good of a fix on what is going to happen in the future.

Besides that, when you're looking in terms of hydrology, probability analysis--if you had thousands and thousands of years of record you could get a real good indication of what the probability of flooding was going to be in the future. But that doesn't necessarily mean the probability of flooding in the next 30 years. It may be real good for an infinite period. But for the next 30 years or the next 50 years that you're really concerned about in your life span, that probability may not be right at all. The next 30 years may be wet years, they may be dry years.

So, even though you have the best possible analysis of what the probability conditions might be in the future, is that right for the next 30 years. Is that right for the next hundred years? You say it is, you know in a lot of cases on the average it will be, but it's not going to be for a particular project or a particular area, it is probably not going to be right. Like having one foot hot and one foot cold, but on the average you're comfortable.

Q: So in your side of the business, you really have to be more conservative.

A: Well, we feel, or most of us, feel that you should be conservative because to error on the low side or I mean to error on the one side, the consequences are more severe than they are in the other direction.

Dam Safety and the Big Flood

Q: Do you want to continue your comments on the conservative nature of hydrologists?

A: Well, of course, I guess one of the biggest areas where conservatism comes into the picture is in dam safety and the probable maximum flood. Are you familiar with the probable maximum flood, have you heard about that?

Q: I have, but very sketchily.

A: Well, in the case of the probable maximum flood--early on back in my early days they would design spillways and top of dam, with a combination of top of dam and the spillway, so that it could pass very big floods based on statistics, which we had short records and we don't know how to estimate rare frequencies because we don't have a long enough record, of course. Still don't and probably never will have a long enough record to do a good job on statistics.

But people were estimating lO,OOO-year floods and saying, "Well, this lO,OOO-year flood--we'll design our spillway to pass that 10,000-year flood." When, in fact, the curve that describes probability can flop in either direction quite a ways.

So the Corps was looking for standards. Some sort of a standard that they could use to judge one project against another. Since they knew they couldn't do very good with statistics, in trying to come up with good information on statistics, they were looking for some other parameters to form a performance standard, so to speak. So they could say, "This project is built to the same standard as some other one."

So that is when they got really interested in working with the Weather Service on our flood potentials--you know, what is the potential, what is the most extreme flood you could get here? The Weather Service says, "Well, we can give you some rough estimates on over that particular drainage basin, what the biggest storm might be." You can figure the hydrology that goes along with it.

But we haven't studied the stuff enough to really know for sure. We need to have a lot of data, and we need to do a lot of studying in order to do this sort of thing. So the Corps says, "Well, why don't we work together." The Corps will go out and get information on all the biggest storms that have happened all over the country. They'll spend the money to go out and get the data on those storms. "And we'll feed all this data to you and you can use that data and your expertise in meteorology to come up with the biggest storms that you can get anywhere in the country." That was the philosophy. So the Weather Service says, "Sounds good, do it. We're willing to do that."

So they had a storm study program. The Bureau of Reclamation got involved in it, too, and so did the Soil Conservation Service. They would go out in the field, and they'd get all the information they could on historical storms. The storm occurred say in 1908. They'd get all the data that had been taken. They'd go out andinterview people who happened to live in that area at the time of the storm and find out if they had any historical notes or anything that could tell them how much it rained and how long it took for that

rain to take place and all that kind of stuff.

So they got all kinds of good data from the storm study program. There were a lot of storms studied, and the rain distribution intensity and all that stuff was developed for all the storms. The Weather Service used that, then, as a base for working on maximum probable floods--at the time they called them maximum possible storm. They finally changed the name to probable maximum because they wanted to get across the idea that it wasn't necessarily absolute you could get it but something that was reasonably possible. So they called it probable maximum. The Weather Service worked up generalized procedures for coming up with that rainfall.

Well, here is another area of difference between the Corps and the Bureau. The Bureau was having a tough time supporting the cost of their projects. Doing something like this and coming up with extreme storms to design their spillways for them or something like that, it's going to make their projects a lot more costly.

So they weren't so sure they wanted to just go into this with everybody else and let the Weather Service make all the decisions on the storm. So they did their own analysis of storms out in their area. They said, "We'll do our own storm analysis and decide what the probable maximum flood should be out here." The Weather Service has ever since then been doing the probable maximum storms for the Corps. Then the Corps takes that probable maximum storm and turns it into a probable maximum flood which in turn is then used to design major dams. The whole concept of that has been questioned by people since then but this is just what happened early on.

So what happened is that the Corps and the Bureau were working in the same area and were getting much difference in their probable maximum floods. The Bureau's were much smaller than the Corps'. Primarily motivated, I'm sure, by cost. They didn't want to spend the extra money for the big spillways, so they argued that they would use all of the logic that they could come up with to say that the storms couldn't be that big.

Whereas the Weather Service, they didn't care one way or the other what the cost was. They just said, "Well, based on our experience and knowledge about storms, we could move them around and the storm that happens here can happen over there and so forth." They would maximize the storm. They moved the biggest storm in the area over to this other location and then they would decide what this transposition did to the storm. Would it make it rain more or less and so forth, depending on the elevation and all or the geography of the area and all that kind of stuff. They have published a lot of documents on how you do this sort of thing.

But anyway, there was so much political heat about the difference between these probable maximum floods between the Corps and the Bureau of Reclamation that I think it was the Assistant Secretary of the Army for Civil Works got together with the Secretary of the Interior at some party somewhere and they got talking about their differences. They said, "Well, we need to get together and have the top hydrology people in the Corps and the Bureau get their heads together and come up with a same procedure for doing this. We want to find out why there is such a big difference and we want to get that difference solved."

The Chief of Engineers told me, "You are going to be my representative for the Corps to get this thing straightened out." The Bureau of Reclamation also had a representative that had been named, and we had some meetings. We found out right away that the techniques we used for transferring the storm into hydrographs were pretty much the same--that you couldn't get much different answers if we both started off with the same rainfall, our answers would come up pretty close to the same hydrograph.

So we realized right away that the big problem was in the probable maximum storm, not the hydrograph, but in the storm. Since the Weather Service was doing it for us and the Bureau of Reclamation was doing their own, the controversy was between those two agencies not between the Corps and the Bureau.

We had to get the Weather Service and the Bureau of Reclamation working together trying to see how we could resolve this thing. We finally set up a committee of several agencies and how we were going to do this inter-agency thing.

We agreed on all the stuff east of the 105th [Parallel], primarily because the Bureau didn't operate east of the 105th. So they agreed that we would all use the Weather Service's stuff east of that area. But west of that, where the Bureau operated, there were going to be some more problems about how we went on doing that.

Well, about that time the guy who was in charge of storm studies for the Bureau retired. They started looking for new staff, and they hired somebody from the National Weather Service to do the meteorology studies who had been trained in doing it the way the National Weather Service did it. Not only that, but they were also looking for a new chief of hydrology. It turned out the guy that got that job had been working in the office in San Francisco for the Corps and in Albuquerque, and he wanted to get back to the Denver area where he was from. He got the job as the chief of hydrology for them.

Both of those guys were trained in doing things the same way the Corps did. So they started influencing what was happening in the Bureau of Reclamation, even though they had some tough sledding they turned the Bureau around as far as the probable maximum

floods were concerned. Dealing with some of their bosses, we had some conferences and there was a lot of controversy and so forth. You're always going to have continuing controversy on that subject.

But the Bureau has really turned around on probable maximum flood. It has gotten them quite a bit of work because they can build up their projects-do redesign on some of their projects. They went into Congress with a Dam Safety Bill, and they said, "Hey, we've got all these projects that need to be upgraded, and it's up to you to give us the money to do it."

Well, the Corps didn't do that. They took a different approach in trying to upgrade their projects. They were all presumably designed for the probable maximum flood, but through the years, changes have taken place and some of those probable maximum storms were actually bigger than they had been when they were originally derived. So the Corps had some dams that weren't up to the top standard either anymore.

Then we got into the Gianelli [William Gianelli, Assistant Secretary of the Army for Civil Works, 1981-1984] era where he didn't want to spend any money on dams or dam safety or anything of that nature because the administration didn't want to spend it. He was very strong in not spending any money and dam safety was one of the things he wasn't too interested in. We had a hard time selling dam safety to him because as far as he was concerned anything that had such a rare probability of happening, why he didn't want to waste the government's money on it.

While he wanted to give a little token support for dam safety, he really didn't want to spend a lot of money on it. We didn't get very far with him on the Dam Safety Program while he was there. Since there were people promoting this concept of using risk analysis in designing the safety of dams and there are a lot of highly competent people that were promoting risk analysis when they designed dams.

Of course, that brings the economics into the picture and it brings probability of floods into the picture, rare floods, real rare floods, which all the statisticians say you can't do. But still people would come up and say they could do it. It means things like evaluating the loss of life. If you've got a big dam, like these Missouri River Dams, and they fail, a lot of people are going to drown likely. What is their life worth? All that kind of stuff really has to be cranked into the studies if you're going to do a real thorough risk analysis study.

There were quite a few years where there were all kinds of meetings going on. All kinds of conferences promoted on dam safety. Then the Federal Emergency Management

Agency [FEMA] was formed, and they got the responsibility for any major disasters in the country. They were supposed to be the leader on what the Federal Government did in the area of dam safety and other hazards.

But they didn't really have a lot of expertise on how to do it, they just kind of tried to organize everybody else They were the chairman of the committee, but they didn't necessarily have the best expertise on it, they just tried to get the other agencies together and so forth. They had a lot of private people working on it. Stanford University worked on it, MIT worked on it, and we had some real firm debates out in Stanford and up at MIT on what you should do in dam safety.

A lot of these people that were promoting real strong for risk analysis, one of them in particular, he was one of the most ardent proponent--or had the strongest argument about using risk analysis and probabilities. I would argue with him about, "Hey, you can't compute probabilities that accurate." He was a real expert on statistics. He'd say, "Ah yeah, we can do just as good on that as you can on the rainfall for the probable maximum flood."

But after they published one of the books on those committees from the National Academy of Science, he wrote a chapter in the document on risk analysis. He went back to his home university, and he actually took on a review of some dams up in that area in New England to see how he could design those for risk analysis. He ended up finding out that he really couldn't do it. He couldn't get the answers to come up good enough. There was so much variability in his probability analysis that he couldn't get a good answer, a good definitive answer in risk analysis. He even stated so in another publication after that.

But there are so many theoretical people from the university who think things should work by theory until they actually get out in practice. There has been a lot of that happening. Professors beat the drums and write papers and give speeches and stuff on how to do things and then when they actually have to go out and prove their technique in a practical way, they can't do it. But they get everybody allexcited about it, you know, in doing it that way.

The Gap between the Scientific and Practicing Engineer

Q: Is the value of your advisory committees, bringing in these people to see some realities and the value of an organization like ASCE, bringing your academic colleagues in with the practitioners who have to do these things on a day-to-day basis?

A: **Now** there is a gap between the scientific and the practicing engineer, and it's a tough gap to fill because you don't have very many people who know enough about theory. Practicing engineers--most of them don't have the time to spend at all on the calculus and things that goes into some of these theoretical applications to really understand how you apply them.

The scientists, they come up with these theoretical ways of doing things, but they don't have the time to find out whether they can get the data that goes into their procedures or their formula and their models and so forth. So they just go on saying, "Well, it must work, theoretically it's sound."

That was one of the reasons that the Hydrologic Engineering Center [HEC] was established out in Davis [California]. It was to try to get people out there who had enough smarts about the scientific side of the house and yet apply these things in the practical sense, try to apply scientific theory to practical problems and see if they couldn't bridge this gap and get more of these theory--more of the scientific theory into the hydrology then had been in the past. But only if it was going to be useful, not just because it would look good. They've done a pretty good job on that.

Of course, that is nearly impossible to do. But they've done a fairly good job whenever they try to apply some of that scientific stuff, which they have gotten from different professors. They're located in Davis, California, right next to the University of California in Davis. They interact a lot with the professors there. At night you see HEC people who teach courses over at the university so there is a lot of interplay there.

But it has always been a tough problem with this communication gap between the scientist and the practitioners. Well, ASCE, I think, is the best organization for trying to bring the two together. AGU [American Geophysical Union] is not as good an organization for this purpose because it is primarily scientifically oriented. Most of the people who belong to that organization are professors and scientists of one type or another whereas the ASCE has more of the practicing engineers and they have a lot of professors, too, in ACSE.

So they get together more and they get a better chance to understand each others point of view. Whereas in AGU you've got one scientist talking to another scientist. Neither one of them have had any practical experience maybe in what they're talking about.

I think of my experience when I was taking graduate courses at Catholic University. I got a Master's degree there by going to school at night for five years. One of my professors was a guy by the name of Ken Young, who has an engineering firm here in Springfield now. He was relatively fresh out of school and had his doctor's degree and all these fancy

things like dynamic programming and linear programming, water resource studies, and that sort of thing.

He had a lot of good theoretical stuff and was a real good professor as far as knowing all the theory and things that go into it. He was working for the Federal Water Pollution Control Administration at the time, and they had some kind of backward methods for doing hydrology. He would come to class and tell us about how his agency was doing things wrong, and he assumed all the agencies were doing them wrong, too, because his agency was.

He would tell us about, "Well, here is the way it should be done but it's not being done that way in my agency." I'd say, "It hasn't been done that way in the Corps for years." So it is your agency that is backward not the whole government. Anyway, he was going to bring everybody up to speed on how to manage reservoirs with dynamic programming.

He was going to use dynamic programming because he had written some articles on how to do it. But in order to do it you had to have loss functions. You had to know that certain losses would take place if you didn't have enough storage or if you didn't get the proper releases downstream for all these various purposes such as water quality, main&ream fishery, and all those good things. About the only things you could tie down the loss functions on were hydropower and flood control.

You couldn't tie them down very good on water supply because you don't really know what the benefits of water supply are other than the fact that if people are willing to pay the price for it, it must be worth it. So that doesn't really give you or tell you much about the benefits of it. All it tells you is that they were willing to pay that price for it.

But then I would say to him, "Well, Ken, you know you're teaching us this stuff about dynamic programming, and we have loss curves." I said, "Where did those come from?" "Oh," he says, "Well, that's up to the engineers to go out there in the field and get them." I said, "Don't you realize it can't be done?" "Oh yeah, they ought to be able to do that." I said, "Ken, it's impossible to come up with any kind of relationships for some of those beneficiaries that you're talking about and work them into a program where you optimize the operation so you get the most benefits." I said, "It don't work that way." I said, "It can't be done."

He says, "Well, it's got to be done." He wouldn't even listen to me until a few years later after be got in his business and he was doing a lot of hydrology and found out that he couldn't get some of the information that he needed. He had learned a lot in the days that had gone by as far as practical application. He didn't need to learn anymore about theory, he knew enough about that.

But he was telling us about how he used water quality storage at that time they were going strong on water quality storage and he'd say, "You can use this water quality storage for flood control." I said, "What do you mean?" "Well, you can use water supply storage for flood control." I said, "Well, that theory is all right out in the West where you've got snow to forecast runoff and you can have some idea what your floods are going to look like." But I said, "How are you going to do that out here in the East?"

He says, "Oh, well, the Weather Service, they've got this good forecasting from radar now. They know where storms are and where they're going to travel. They can see the storm coming over this area, and you've got two or three days, you can release the water out of the reservoir and have the reservoir empty for when the storm comes over the basin. Then you fill it up, fill the storage back up again."

I said, "Well, that sounds great but what are you going to tell the city fathers that are depending on that water supply to provide their M&I water for the community if the storm goes the other direction? "Well," he says, "The Weather Service, they need to know how to get forecasting down so they can predict that." I said, "Well, you're forgetting that they're not capable of doing it." So it's just little things like that if you don't think about them or pay attention to them, the theories go right down the drain.

You can imagine what a community would say if you had let all of their water supply out of the reservoir because a flood was coming when the flood didn't materialize. Then they didn't have any water for water supply. They would be really angry. Probably run you out of town and tar and feather you or something.

Q: At the very least. Well, a critical problem has always been the gap between theory and practice.

A: It's a tough one to fill because people are really oriented toward the scientific bent. Like to deal a lot in equations and procedures that are easy to work out to a neat answer. But most people who work in engineering, they got problems from their textbook that always worked out to nice neat answers. But when you got out in the field, and you try to apply them with that same procedure to actual data, it never works out.

You can't get a nice simple answer from the data you get out in the field. It just never works out. You've got to make some adjustments here or there or try to figure out why this storm didn't really give that amount of water or was there something different than they apparently observed there. Crazy things happen.

One incident I think about--I often think about when I think about accuracy of data--the Weather Service had a real big water content in the snow in a particular location where a rancher was the recorder for the snow. All the rest of the area, nothing had that big water [content]. They couldn't figure why there was such a large precip content in the snow in that area.

So they went out and they questioned the lady who was contracted to do the job. She was saying she knows darn well about that information--she is very cautious and conservative about how she did her work and careful so that she sent in the right [data]. She said, "I collected the sample snow and I melted it down and I measured the water content and I got the right answer."

It just happened that her husband was sitting in the next room listening to all this conversation. Finally he felt guilty enough and he got up and came in and said, "Hey, excuse me, I hear what you're talking about and you're having problems with the data." He says, "The reason you're having problems with that is because it's my fault. He said, "She put the containers on the stove to melt the snow." He said, "She told me as soon as it melted to take it off the stove so she could measure it." And he says, "I forgot about it and the thing boiled dry." He says, "So I just dumped some water in it and she measured the water I dumped in."

Here the Weather Service had been publishing that as an official record for some time, and they had never been able to explain why it was so different there. But those kinds of crazy things happen.

Q: Well, I would imagine when you deal with a lot of people as your data gatherers you've got that as an error probability, too.

A: Oh yes. There is a lot of that that goes on. Well, a lot of these people are volunteers. While they may be conscientious, they don't get enough money to really do it, if they weren't interested in doing it on their own. I used to go out and help sign up these people when I was in Garrison to do some of the gauge reading. We would pay them instead of the Weather Service. They'd give the data to us and to the Weather Service. But the Corps was paying them because we needed it to regulate our reservoirs.

Some of those people, they were really doing a lot of work for practically nothing. They would get like a couple bucks a reading or something like that and might have to drive five miles from their house to a gauge.

Q: How much has the Corps gone into automated data gathering where they have a remote station?

A: They do have some of that but it's so expensive that it can't really cover all of the areas. You still have to use a lot of this individual help. There are all kinds of volunteer helpers as far as rain gaugers are concerned. They have a lot more automated stations now than they used to have, but they are still far from being adequate to cover all that they would like to have.

Q: Because you're dealing in all of the basin areas?

A: Yes, the basin is so big and the variability of the rainfall is so great that the changes--well, just like in Washington here. It can be raining like heck over at my house and not even raining at your house. I measure two inches of rain and you measure zero. If you don't have any measurement device over at your house, you may assume it rained two inches at your house, too. See that's the kind of a problem we run into in getting good information on rainfall.

You can't get the gauges close enough together to be sure you've got a real accurate measurement of the aerial distribution of the rainfall. You do the best you can.

Projects Relating to the Garrison Dam

Q: Now when you went to Garrison in '53, the dam was under construction. So what kind of projects were you involved with there?

A: Well, some of the projects related to the Garrison Dam itself. I was in the hydrology and hydraulics branch. The first year I worked there I worked in hydrology. I did a lot of work on small projects--we were starting to regulate the reservoir even though the project wasn't complete, we were still filling the reservoir and we still had to make releases and forecasts on inflow and decide what the release is going to be and that sort of thing.

We were getting instructions, we had teletype connection with the other districts and also with the Missouri River Division. They would give us instructions on generally what we were suppose to do and then we would have to try to figure out--one of the problems we had, of course, in a big reservoir like that was knowing what the pool level was.

We were getting inflow based on the difference in the water surface at the beginning of

the day say and the end of the day. Then knowing the water that you'd let out of the reservoir you could figure out what the inflow was. The problem was you didn't really know what the water level was because the wind was blowing so hard. You couldn't get any real accurate information on the water surface. Just a little bit of difference in water surface made a lot of difference in Q, in inflow.

If you were off--sometimes we'd go for four or five days where we were just kind of guessing at what the inflow was by extending curves that we had developed from previous days. But until we got to a day where it was real calm, we wouldn't know for sure what the level of the reservoir was. Then we would have to go back and readjust our estimates for those previous days when we got a day where we knew pretty sure what the water surface was.

So there is a lot of guesstimating and things like that that you had to work with. Even with the best tools, you can't be that precise on those big reservoirs level. You can have gauges half a dozen different places around the reservoirs, but still when you're dealing with hundreds of a foot, that one hundredth of a foot will make quite a bit of difference in your flow. It's very hard to be that accurate.

Q: Yes, because you're dealing with some pretty large reservoirs.

A: Oh yes, those are big projects. But then that was part of my work. Then we had some levee projects. We were studying levee projects. We would go out, during flood periods, and look at damages that took place during the flood.

One of my experiences was flying out with aerial observation of flooding in the district. The pilot owned his own airplane, and he would fly it out and we would go over all the area and make observations of what area was flooded and what was happening out there just by flying over it. This guy was crazy when he was flying that airplane. He would fly under wires and he'd dive down in the valley there and he'd be steering the airplane with his knees and taking pictures. He was also the photographer.

He would be heading right at a mountain or a hillside taking pictures. Then all of a sudden he would grab the stick and pull it. It would go zoom upward. It was quite a thrill to go out with him.

Q: It sounds like it.

A: I did that on a few occasions.

Q: Sounds like one of those thrills you could bypass though.

A: I had a lot of interesting things happen when I was young.

Hydrologic Engineering Center (HEC)

Q: Did the Corps initiate any training projects for hydrologists while you were at Garrison? Was there any kind of training or was it just what you learn on the job and from your supervisor?

A: I just don't remember. I don't remember any courses really being available other than what you learn from your on-the-job training at that time when I was in Garrison. It wasn't until really the Chief's office had a few training courses before HEC was put into operation. But up until HEC was put into operation, there really wasn't any good training program for hydrology. There was no systematic training.

For example, a division office might get some of their hydrology people together in kind of an ad hoc basis and give them some advice and guidance. But there wasn't really any formal programs going on, certain courses being taught and you knew what the content of that course was going to be. If there was any training done it would be on a need-to-know basis. Something new would come out and so one person maybe in the division would figure out what it was all about and then he would get the rest of them together and tell them about it.

It wasn't something like they have now where annually they decide on which training programs they're going to conduct and they send that list out and they find out what the interest is in it. If there is not enough interest they cancel some of the courses and add some others. So it's pretty formalized nowadays. They have--I don't know what the hell they call them--each course had it's own advocate or whatever. He was responsible for making sure that all the right stuff was being taught in the course and that it had gone on a training list when it was needed and so forth.

Then, after each course the HEC publishes one of these big folders like this. There are all different courses that HEC teaches. As they learn a little bit more, the course changes a little bit.

Q: But you key a lot of that change to the establishment of the Hydrologic Engineering Center?

A: That's how it got started and got formalized. They designed courses for specific purposes. They designed hydrology courses for planners so they would learn enough about hydrology so they could do a better job in planning. You know historically hydrology, for example, has been a training ground for a lot of the planners because the basics of hydrology are what they need to do good planning. If they don't understand hydrology, it's pretty hard to do water resources planning.

That's another area where the Corps has kind of gone through different phases of how they handle things like planning or like water quality. Years ago when I first started--in that branch in Garrison District we had a sedimentation section, a hydrology section, a hydraulics section, and the reports section they called it. I worked in three of the four sections there.

But a reports section is really what we call planning today. Well, the planning at that time had a very small niche in the whole program. It was done in this reports section. But as we got into these Water Resources Development Acts by Congress, and they wanted more planning in this economic analysis, more sophisticated planners became more important all the time. It was tough to get that going the way Congress wanted it done.
Because first of all your top civilian in the district office was the chief of engineering. He had the highest grade and when the District Engineer needed any kind of a decision on the technical matter, he would go to the chief of engineering. There was continuity from year to year on what had gone on in the past on technical decisions because the same civilian stayed there usually for a long--some of those chiefs of engineering were there for years and years and years. They weren't about to start any of this new planning crap. They didn't like it and they knew how to design things, they didn't need anybody to tell them how to do engineering.

So it was very difficult to get planning off the ground. But when they did start getting planning positions, where did they go to find people to fill them? They went to the hydrology people. A lot of the top jobs in planning, the early planning bobs], came from the hydrology side of the house because they were the only ones that really had enough background to do some of the planning until the Rivers and Harbors Board [Board of Engineers for Rivers and Harbors, BERH] got their training program started so they actually had real formalized training in courses for planners where they would bring them in for a whole year and train them in how to plan projects.

Then the top jobs started going to those people that had that kind of training instead of picking from some other job like hydrology. But even the people that went to those courses, a lot of them were in hydrology and they went on and got that additional planning

experience and went into the planning field. So many of the planners have a good background in hydrology.

Q: Well, that seems to be the basis for everything in the Corps now.

A: Well, if you don't know whether the water runs uphill or downhill, you're in trouble.

Q: Doesn't make any difference how good the dam is, right?

A: You need to know about storms and droughts and all that kind of hydrology in order to do any planning at all.

Q: You mentioned the chiefs of engineering divisions. For many years the Corps was accused of being resistant to change, and largely because of the people who had been in these positions, who became virtual institutions in themselves. In your experience in the Corps have you found it to be an institution that does adapt to change relatively easily?

A: Well, I think in those earlier days it was pretty hard to change things like planning. First planning came along and that was hard to change. Finally in order to treat planning the way the Congress wanted it done, they had to actually set up separate planning divisions within the districts. So you had a planning pipeline that went up through channels. You had an engineering pipeline. The two had a hard time interchanging a lot of times.

They created a real monster by doing that for the district engineer because now he has a chief of planning and a chief of engineering, and they both have the same status. When he's got a technical problem, who does he go to? Which advice should he accept? So he would have to end up making decisions on technical matters he really is not trained to do. He was really stuck.

If the planner in most cases is more articulate than the chief of engineering, who is probably a structures man, he can convince the district engineer to listen to him more than the chief of engineering can in most cases. At least it has been my experience that the chiefs of planning, they really had a way about them because their job primarily was convincing people that this project is good and these are the things that make it good and all that kind of public relations. That was his job.

Whereas the chief of engineering, his job was to do technical things and not really deal

much with the public. He didn't have to learn all those communications skills as thoroughly as the planner did. So he wasn't able to communicate to the district engineer a lot of times as well as the planner. The planners kind of got the upper hand then over the chiefs of engineering, I think, for many years.

In all. I guess. they keep changing around. I think they're kind of almost back to where they were before now where they've got a new chief civilian in district offices who is--what do they call him now--who follows the projects. What do they call that stuff?

Q: Project management?

A: Well, it's a project management concept that was introduced a few years ago.

Q: Well, it was one of the initiatives of Bob Page when he was Assistant Secretary of the Army for Civil Works, wasn't it?

A: Well, they follow every project. One guy follows the project from it's inception all the way through, and they have real limitations on what you can do to change the project once it was authorized by Congress. So that guy apparently now is the top civilian in the district office, so now there is one guy who is the top civilian in the district office. We don't have two or more all trying to get the district engineer's ear, so to speak.

So there are advantages and disadvantages of both concepts. But it's tough for a district engineer when he gets put in [this situation]. Well, not just a district engineer but the Director of Civil Works.

For example, the Director of Civil Works, he has tough decisions to make. He has had different organizations through the years but when he has many divisions and different points of view, a lot of times he has to end up deciding what is the best technical decision. Really he shouldn't have to be put in that position because in most cases he really [doesn't] know for sure what is the best technical answer.

It is pretty hard for him to judge when the Chief of Planning says, "This is the right answer." The Chief of Engineering says, "No, it isn't, this is the right answer." It's pretty hard for him even though they both do a good job of explaining their points of view, why it is still hard for him to make that decision whether he has made the right one or not.

I don't know what the solution is to that part, but how do you avoid him having to make those kinds of decisions? But, it is just the way the Corps of Engineers works. They

don't have the continuity. The Director of Civil Works is there for three years or so, and the new one comes along and he has to learn which guy he can put the most confidence in., It takes him awhile until he figures out which one gives him a lot of baloney and which one gives him the best information. By the time he gets it figured out, he leaves.

Q: Yes, that's one of the big problems. The point being the same one that you made, too-- that they're not really technically that proficient.

A: Well, they have technical training, obviously, but they haven't been practicing it. They are so busy doing management that they don't have time to sit down and do a statistical analysis or a backwater study or a structural design problem or something like that.

Waterways Experiment Station (WES)

Q: Yes, most of those guys who go that way don't end up as Directors of Civil Works.

A: They go to the Waterways Experiment Station.

Q: Which brings up a question. When you're sitting up there in a place like Garrison and you have problems, did you get a lot of support out of WES? Did they help you at all? Were they at all involved in hydraulic studies?

A: They're very active in hydraulic studies. They're not the organization to do hydrology studies because it has never been emphasized at the Waterways Experiment Station. Especially after HEC came into the picture.

Now WES does some hydrology studies for other military elements, not the Corps of Engineers, but other elements of the Army. They do some hydrology for battlefield hydrology and stuff like that, which I'm not so sure they know what they're doing when they do it, but they do it anyway and the Corps has no control over it.

As a matter of fact, I recall one year when I was in charge of hydrology and hydraulics. The Waterways Experiment Station got a research job from another element of the Army, and they were holding a nationwide conference on what approaches they should be using to do the studies that they were doing. They didn't even ask me to come to the meeting. They then asked the Hydrologic Engineering Center to go to their meeting. Here the whole subject that they were dealing with was hydrology.

They had all the other agencies. They had the Weather Service and the GS [U.S. Geological Survey] and professors and everybody, but they didn't have the two most prominent elements of the Corps of Engineers involved in their discussions. The only way I found out about it was somebody from the Weather Service called me up one day and said, "Hey, what is going on with this meeting down there? What are you going to do down there?" I said, "What meeting?" It was ridiculous.

Q: What was their explanation?

A: They didn't have any. They never did say why they did that. They didn't have to explain it, they didn't have to explain anything to me, they don't work for me. They didn't work for the Director of Civil Works or even the Chief of Engineers when it came to that job. It was for somebody else. But it just blew my mind to think that anybody that was going to do something like that wouldn't at least contact the people that they should have been the closest to.

Apparently, they felt that they didn't want to be bound by traditional procedures that had been used in the Corps. They wanted to come up with new ideas, I guess. I don't know what other explanation they had for it.

People: Leo R. Beard and the Hydrologic Engineering Center

Q: When the Hydrologic Center was formed, was that formed from people taken from the Corps? Was it an element taken out of WES or was it just formed mostly wholly new?

A: What happened is that they had research money. All the various elements: hydraulics, hydrology and soils. Everybody got some of the research money. They had a pot of research money every year and they divvied it up depending on who could do the best talking and who they claimed they had the most needs. Hydrology got a chunk of that money, too, and they would use it for a lot of purposes such as storm studies and other useful activities.

But they were concluding a lot of those storm studies and a lot of the special studies that they had been done, unit hydrographs studies and others. A person that was in OCE, [Leo R.] Roy Beard, I'm sure you've heard of him if you've been interviewing anybody in hydrology. His name always comes up because he was the first director of HEC. But he was in the Chief's office, and he is a guy who wrote the first textbook for the Corps on hydrologic statistics.

Actually he did not necessarily develop the basic theory behind it but did the application of the theory to storms and floods. He developed a book on statistics for the Corps. It turns out that it is the same technique that the interagency hydrology committee agreed to use today and published it in a document called Bulletin 17B, *Guidelines for Flood Flow Frequency Analysis.*

He was a real sharp guy in all areas of hydrology. Statistics was his primary field, but his wife didn't like Washington. So, Al Cochran didn't want to lose him from the Corps, he wanted to do something to find a place for him so he would stay in the Corps. Roy wanted to go back to California. So Al got together with Gomez out in Sacramento District. He was Chief of Engineering, I think, at that time.

He said to him, "Do you have a place for him in Sacramento? Could you find a spot for him to work out there?" So Gomez says, "Yeah, we can always use a real top notch guy like that. We'll put him in charge of a section." He was put in charge of the water control management section there in Sacramento. Of course, that created a little bit of problem because he came in at a higher grade then some of the other people had out there. They didn't reduce his grade when he transferred. That created some problems as far as in-house concerns. And it wasn't too good from that standpoint.

After he had been there for a little while, Al came up with this idea. Why shouldn't we have some place where all special hydrology work is done independent--not completely independent but at least have it's own home. Roy happened to be in Washington for some other purpose, and Al took him out to his house for about three days or a weekend to tell him all about his ideas on what they ought to do.

As Roy says, "I listened. I didn't get a chance to say much." But when Al got all through with his ideas they had come up with a concept for the Hydrologic Engineering Center. It's not much different than it is today. They would use money from research to get this thing started and just have a few people to begin with.

They talked to Gomez in the Sacramento District about taking charge of all the administration that needed to be done for the Center. But they decided that it shouldn't be located right within the same building as the Sacramento District because it had its headquarters ties and headquarters would really be telling them what to do. So they didn't want it right in the District.

They moved it out to Davis on the grounds that it was close to the university where they'd get all this theoretical input and so forth. They moved it out there with a small staff to start it off with, and it just gradually grew and grew from there. By doing good work they

were able to get more and more money to do more things. It not only became a great organization for hydrology, but planners really wanted to use it, too. It got so that it was doing more and more planning.

They added a branch, a Planning Branch, to the HEC after it had been in existence for a while so that it served not only hydrology but planning, too. For quite a few years the hydrology people in Washington called the shots and got all the money for it. Then, as time went on and it got more and more involved in planning, they had some reorganization on who was going to call the shots for HEC.

The Institute for Water Resources [IWR] ended up being the ones that theoretically were their bosses. Although they didn't have much capability to give them technical direction except in the planning area. So the headquarters hydrology people still had to go out there for the annual meetings.

I guess they still do have an annual meetings where people from headquarters and any of the field offices that want to attend. They would go over the program that HEC was proposing for the next year and give them direction by saying, "We don't like that too well. Spend more time on this and less time on that. What are you going to accomplish and what have you accomplished?" Those meetings used to be pretty interesting. We'd get into some pretty heated debates sometimes about what was most important.

Q: So they would come up with a theoretical research program then for a fiscal year?

A: Right.

Q: Were they doing reimbursable work at the same time as that?

A: Some were, yes.

Q: But mostly research programs?

A: Well, a lot of their funding through the years has been reimbursable work. A district would have a special problem and, rather than going out to private interest to get the job done, they would go to HEC. The whole concept was, "Hey, give us your tough problems. If you've got a tough problem that you're having a hard time figuring a way to handle it, give it to us and we'll try and solve it for you. That way maybe we can apply

some of this theory that people have been giving us and wanting us to try out. Maybe we can work it into a solution to the problem that you've got."

So they did, in essence, come up with a lot of ways of handling special problems simply because they were this group that handled communication gaps. The districts really didn't know how to apply some of those theories to the interesting problems that they might have. The problem I had was trying to control districts who wanted to use HEC as just another source of help. Just routine help. I said, "Well, we don't want to use the resources of HEC for routine help." If you don't have something special to do, go out and get a consultant to do it. Don't use HEC, go to some other district and use them.

Q: You didn't want to destroy their research program for that kind of thing.

A: You see they always have been pretty well constrained on how many people they can have. They didn't want that place to get too big. Their numbers have been like about 30 full-time people, 32, maybe 34 or something like that. But they never have been able to expand it much beyond that. Headquarters just doesn't want to make it a real big outfit. They could have some temporary help, but they just didn't want to make a massive organization.

Q: From a hydrologist's point of view, has that been a good decision or a bad one? Would you rather see it go larger and do more things?

A: Well, I think there is a danger in having to be too big. The danger is that pretty soon it doesn't have enough work. So what it does is, it goes out and takes all these routine jobs from the districts and the first thing you know in the districts, they've got problems and constraints on help and so forth. If they know that they can get the work done at HEC, then they'll eliminate the hydrology staff in their district and say, "Hey, we can get along without them. HEC will do all our work for us." I think that's bad when it starts doing that sort of thing.

Q: Because the districts really need to have their own hydrologists.

A: They need to have a hydrologist--they've got to have them. Especially if they are a district that has reservoirs, because the people who really have the knowledge on how to operate reservoirs are the hydrology people. They're the only people who really have the

background experience to know how to effectively operate reservoirs and how to get the most out of the storage. How to do the reservoir regulation studies.

That was one little problem that I had with John Morris when I first came to Washington. He was the Director of Civil Works. He had some concepts when he was in Missouri River Division of putting the water control management that McClendon was in charge of under the Operations Division. His argument for doing that was that, "Hey, the people who come in contact with the general public are the operations people. They're always asked questions about, 'Why are you making these release rates?' None of them know what the answer is." They said, "Well, you've got to call McClendon. He's the one that decides all of that."

General Morris said, "Water control management ought to be part of the Operations Division." So we had a little argument about that one day in his staff meeting, and I told him, "You really don't want to do that." I said, "In the first place the people that know how to do water control management like McClendon come from a hydrology background. When you get into district offices where you have water control management responsibilities, they don't have extensive work all year round. They have a lot of work to do during floods and during emergencies and droughts. But they don't have a nice steady load so to speak."

Their load varies. So if they are a part of the hydrology group, they can work on planning studies or design memorandum studies when they're not doing their water control management. So you get more effective use out of them, you get to use their hydrologic knowledge. Otherwise, if you didn't do that you'd have them doing some routine thing that didn't take advantage of their expertise in hydrology. You'd have them out there mowing the grass or some darn thing just to keep them busy.

Anyway, he didn't argue with me about it. He just said, "Well, I still think there is a problem with communication between the public and the people who decide on the release rates. So you need to pass that information out." I have to agree with him on that. But it is just his concept of how it was going to be done that bothered me. He never did anything about it after our conversation unless he kind of decided, "Well, maybe just let it go or something." He never moved on his proposal, and I never heard anymore about it from him after that.

Lloyd Duscha

Q: Well, didn't he tend to favor operations anyway?

A: Well, surprising to a lot of people, he wasn't as interested in engineering, for example, as he was in planning and operations. But he was one of the most ardent supporters of Lloyd Duscha, who he brought in from MRD. Practically twisted his arm to get him into Washington. He was the one who really pushed him for being the top civilian in headquarters, which he was for a while. He was really the top civilian. I think he had the highest grade of any civilian in headquarters for a while.

John Morris was the one who was pushing him. So you couldn't really say that he wasn't concerned about engineering. It might have been that he was so used to having Lloyd out there, who was very competent doing a real good job that he didn't have to spend much time worrying about it. That most of his administrative duties led in other areas, you know, where he had more problems then he did in engineering. So that might have been why people were saying, "Well, he is not as interested in engineering as he is in planning."

Q: You tend not to be worried about things that you know are handled right.

A: I think that's true. If you've got somebody in a job who is really doing a great job and you know it, and you hardly ever have a problem there, why are you going to spend a lot of time working on that area when you've got a bunch of problems in other areas. It's just that the engineering didn't require his attention as much and so, I think, that is probably why he got that reputation.

Francis Slichter and Wendell Johnson

Q: You talk about Lloyd coming out of MRD. So did a lot of other ones including yourself, but I mean people like Francis Slichter and Wendell Johnson, they came from MRD.

A: They came from MRD. Well, I think MRD for many years, in the early years when they had the Pick-Sloan Studies going, they were the biggest organization of the Corps as far as doing big engineering studies and interagency activities. They were probably more active than any other division in the country at that time. So they were obviously the ones that probably had the most competent people to come into Washington.

Francis Slichter and Wendell Johnson were both real top-notch guys anyway. You just walk into a room and those guys stand out. You don't even have to hear them talk or anything. You just look at them and say, "Dang, that guy must be pretty distinguished."

Q: What were they like? You probably knew them fairly well.

A: They just had an air about them that they were very confident in what they did. They didn't act like they were the least bit uncertain about what they should do. They seemed always to present an air of confidence. When you talked to them, they would listen to you very closely. If they agreed with you, they would tell you. If they didn't, they'd tell you why they didn't agree with you.

They were very supportive of their staff. I've never had anybody that I know of that ever made serious complaints about either one of them. None of the branch chiefs ever. They always had a real great respect for them. They used to call them "Mister" all the time, even though they knew them real good, and most of them did, and they still said Mr. Slichter or Mr. Johnson. They didn't say Wendell or Francis. It was just the way they did business maybe in those days.

Q: Well, I know many of the people that I've talked to, including a lot of their top generals, division engineers and district engineers from Mm--people like Tom Hayes--always had a great respect for them.

A: I think they were respected all through the Corps and world-wide for their [work].

Q: Yes, they were more than just engineers in the Corps of Engineers. They were certainly recognized for their skills.

A: Yes, another thing about it that kind of impressed me being a civilian working for the Corps was these fellows. When they walked into a room with a bunch of generals, they didn't appear like they were subservient to these generals. They acted like they were the top guys, just as high or higher than the generals were, you know. Generals didn't bother them at all. They'd talk back to generals just as quick as anybody else. It didn't seem to bother them at all, a four-star general or a three-star general or whatever it was. They were just as comfortable telling them what they should do.

Q: Well, when they've been around a long time people like that, they probably saw these guys as captains and majors, so they think of them as kids.

A: They've been around quite a while, they saw that three-star general when he was just a light colonel, so they're probably not as overly impressed with them as somebody who had never seen them in that lesser role.

But, anyway, it was just kind of funny to me that a lot of the people around, they were always kind of acting like, "Gee, should I even talk to this guy because he's a general" But I never saw those guys ever appear like they were uncomfortable dealing with them.

Redesigning Projects

Q: A while ago we talked about redesigning projects. We were talking about the maximum flood storms. What would you do if you redesigned a project, like BuRec? You said they were redesigning their projects. Would you redesign to give the pool more capacity or would you put more capacity on the tributaries?

A: Well, every project is different--there are practically no two projects that are exactly the same. In many cases, the answer is to make the spillway bigger because it is usually cheaper to make a bigger spillway than it is to raise the height of the dam. It is very expensive to raise the height of a dam. So usually they try to figure out some way to pass more water without causing a problem. In some cases, it is possible; in others it isn't. Like you say, they could also, for example, put another dam upstream that would give them additional total storage to help take care of the big flood. But, of course, that gets kind of expensive too.

But there are a lot of different kinds of solutions that are used. For example, in the Non-Federal Dam Safety Program, in order to do a really intense study, what they called the follow-up study of the initial hydrology and hydraulics, they'd get into a detailed analysis of the dam after it had been declared unsafe. They'd go back and make a restudy. That would cost quite a bit of money to do that more in-depth study.

Some of these dam owners, rather than spend the money to go out and do more in-depth study, would spend the money and widen the spillway or make it a little deeper, big enough to take care of that probable maximum flood that they had come up with in the initial study rather than to make sure that it was the right answer. So it was cheaper for them to send some bulldozers out there and make the spillway bigger in the small dams than to spend all that time studying it. "Hell, we don't get anything by studying, all we

get is another answer--It don't help the problem any. So I'll spend my money doing something constructive." There are a few of them that did that--maybe they don't have the exact answer but they still got a lot more capability than they had before.

The Distinction between Hydrology and Hydraulics

Q: Now something else you mentioned was the Hydrology and Hydraulics Branch. You've already said hydrology is not hydraulics, and WES and the HEC are two different things. Do you want to make that distinction and definition in terms of the difference between hydrology and hydraulics?

A: Well, of course, hydrology and hydraulics have been pretty much together, even though we have two different terms there as far as working relationships because they're so closely related that you don't really know where one ends and the other begins. There is some overlap area there where hydraulics people handle it or hydrology people.

Years ago when this first got started, everything was called hydraulics. There was nothing in the Civil Service register regarding hydrology. There was no such thing as a hydraulic or a hydrologic engineer. You were either in engineering hydraulics or you were in hydrology or sedimentation. I mean your basic engineering was hydraulic engineering. Then under that came hydrology and associated activities.

A lot of the people in the hydrology area said, "Well, hydrology is really more prominent than hydraulics." The hydraulics experts said, "The hydraulics is really the most important." Does hydraulics include hydrology or vice versa, you know, and so on. You don't really find any hard and fast definitions, I don't think, other than design hydraulics for structures, such as spillways, outlet works, and things like that.

There is no question about that being hydraulics. Now when you get into things like backwater studies, in a lot of cases they say, "Well, if it is a natural channel, the hydrology people do it. If it consists of improved channels, with structures in them, with drop structures, with concrete walls and concrete bottoms, or whatever, pipes and stuff like that, then it is hydraulics." But as long as it is natural terrain, then it's hydrology. So, maybe that is part of the distinction.

But, anyway, Al Cochran liked to include practically everything in hydrologic engineering--everything was subservient to that. He was the one who got the hydrologic engineering definition started, and I think a lot of places use it now where they didn't use to. They never used to use it at all. It was either you were a hydraulic engineer, and you

worked in hydrology. But because civil service didn't have any other designation for it except they did have a hydrologist, which wasn't in the engineering side of the house.

Q: Well, the pure science type.

A: Nobody wanted to be labeled as hydrologist because they didn't get as high a pay as the engineers did. Nobody wanted to be a scientist; they wanted to be an engineer. That was in the early days, too, before other disciplines got more recognition, like the economists do get a lot more recognition than they used to. Biologists get a lot more recognition and people working in other environmental aspects.

Q: Wasn't one of the significant aspects about the whole planning division that it now has many more social and behavioral scientists than it has just engineers?

A: Yes, they got away from the engineers running the Corps. The Corps at one time, if you weren't an engineer, why you just might as well get out of the Corps as far as going up the career ladder. You were limited in how far you could go. You maybe could get to a GS-14 at the maximum if you were a social scientist or something like that. The planning side of the house gave opportunities for a lot of those other disciplines.

The economists got to be top dogs in planning. Gedez was Chief of Planning at one time, and he was an economist. I don't know some of the others who managed to get up there. The Corps of Engineers is not necessarily the Corps of Engineers anymore, but the Corps of a lot of disciplines, not just engineers.

Q: Engineers, planners, social scientists.

A: Most anything you could think of.

Q: In the H&H Branch, which we were talking about, when hydrologic engineers come to the forefront, were there people like Cochran involved in getting changes in the whole civil service system?

A: Well, they served on committees. Civil service would have committees to decide how to name various jobs and what kind of names they should have and some of those people

were involved in cornrnittees. Well, I think Lloyd Duscha has been on some committees.

But the makeup of headquarters, of Hydrology and Hydraulics--you'll hear more about it from Jake [Douma] when you talk to him. But when I first went in there, there wasn't much of a hydraulics section per se. There were only two people working in hydraulic design. In OCE they had designated everything outside of hydraulic design as hydrology. They even called the branch that Al was in charge of Hydrology and Hydraulics.

The other group that Jake Douma was in was a Structures Branch, and he was an element of the Structures Branch at that time. There were two people working in hydraulic design, and he was one of them. There was another one who worked primarily in the area in Florida, on the Central and Southern Florida Project. But Jake did most of the other hydraulic design work.

Then hydraulic design started doing more physical modeling down in WES. They needed more help and they got more into the navigation research, and they were doing a lot of navigation-type engineering that the hydrology and hydraulics branch didn't do.

Then they were more involved in the coastal engineering. So the coastal and the hydraulic design part of dams and levees became the big things in the hydraulic design. They really ended up with three sections in the hydraulic design branch--coastal, navigation, and riverine hydraulic design.

But hydrology really didn't get much into the coastal area. Especially into the detailed analysis of coastal studies because there was a Coastal Engineering Research Center [CERC] anyway, doing that kind of engineering. But the people who were directing activities were in OCE and were the hydraulic design people, not the hydrology people.

So, then after a while, let's see, when Al left we were still the Hydrology and Hydraulics Branch. Finally, I guess, when Homer Willis was Chief of Engineering, they decided to make hydrology and hydraulic design one branch. I was in charge of hydrology at the time and Jake was in charge of hydraulics.

Jake being the senior man, obviously got the nod since he had been around a lot longer than I had. It was a natural thing that he would be in charge. But he never really had much background in hydrology, and he wasn't really interested in it either. He didn't really want to be involved in hydrology, and he just pretty much let me do my thing and he did his thing. Even though he was the branch chief at that time, he didn't really give me much direction other than administrative type things.

So, then when Jake retired, I took over as the head of Hydraulics and Hydrology. We even argued when they named the branch, should it be Hydraulics and Hydrology or Hydrology and Hydraulics, which one came first.

Q: Which "H" came first?

A: Yes, which "H" came first, or what did the first "H" mean. Then it got even more complicated for a while. General Bratton [Lt. General Joseph K. Bratton, Chief of Engineers, 1981-84] decided that he wanted to put all the engineering under military engineering. He didn't want to have two engineering divisions.

But Gianelli didn't want everything to go to military engineering because that was out of his jurisdiction. He wanted the control over the hydrology people. So, in that question there was a big battle. That is when I really had a lot of action going on. [Major General] John Wall was Director of Civil Works. Lloyd [Duscha] wanted to take the hydrology and hydraulics with him over to military engineering [Directorate of Engineering and Construction].

They kept asking me what I wanted, and what I thought was best. My central theme, and I beat the drum as hard as I could and as often as I could, to keep it all together. Don't split up the hydrology and put some of it in the Civil Works and put some of the hydraulic design [in Engineering and Construction] because obviously some of the hydraulic design was more related to engineering than it was [to] planning and obviously some of the hydrology was more related to planning than it was to "hard engineering," so called. Like Homer Willis] used to say, "hard and soft" engineering.

But, anyway, everyone who talked to me about it, or would listen to me rather than just come and talk, anybody that would listen to me I'd say, "Hey, I don't care which way you put it, whether you put it in Civil Works or put it in the military side. Just keep it all together. Please, for God's sake, don't screw it all up by subdividing it up into different parts." Well, not only that, part of the hydrology was directly related to the operations, too, in the water control management.

So they could have split it up three ways. They'd have gotten nothing out of it. We would have no power at all.

More People: Major General John Wall

Q: But you wouldn't put it beyond them to do that?

A: Well, Lloyd was willing to do it, and John Wall was willing to do it, and Gianelli was willing to do it, and, I think, General Bratton was willing to do it. But I was the only one who was saying that it shouldn't be divided up. But for some reason, I don't know why they did, but they listened to me and decided to keep it in Civil Works because Gianelli was so strong all the time on having something to say about what hydrology did.

Lloyd agreed to it because he knew me well enough, and we had worked together long enough. He figured he could still work with me even though I wasn't in his division but he did it reluctantly. I mean he wasn't really enthusiastic about it. Whoever was the Director of Military Engineering at the time really didn't give a damn one way or the other. He could care less.

Then they asked me, "Well, what does your organization want to be? Do you want it to be a division, branch, office, etc." Well, we didn't even know what to name it. But we finally ended up saying it was a division, even though it was a light division compared to the others. They called it a division while I was there.

So we were a division for all the Civil Works staff meetings and things like that. But all the other division chiefs had a higher grade, and they had a lot more people working for them. But, anyway, it worked out all right as far as I was concerned because I was able to work for Lloyd, and John Wall never did worry about that at all.

As a matter of fact, he encouraged close cooperation between Lloyd and myself, and I didn't have to go through him on any of the things that I was dealing with Lloyd on, especially on the hydraulic design. He didn't even want to hear about it. The only thing he wanted to be involved with was anything that Gianelli was concerned about. He says, "Anything that Gianelli is concerned about, I want to hear about that. I want to have something to say about it."

Q: Well, I was chief historian for the Corps for a number of years. General Wall had us do a special study of the Office of the Assistant Secretary of the Army for Civil Works.

A: Well, Wall, he was a special person. There was nobody like him, I don't think. He's a one of a kind for sure.

Q: Oh yes.

A: You know a lot of people didn't care for him, but I liked him.

Q: Well, you knew where you stood with him.

A: Oh yes. He always treated me good. He'd listen to my side of the story and even though he'd get different advice from other people, he still would listen to what I had to say. He didn't always agree with me but he would listen and then make his decision. But I always told him out flatly several times, "John, what I'm telling you is for your own protection. You don't have to agree with me and do what I'm suggesting, but you need to know about it before you make the decision. You'd be unwise to make a decision without knowing about what I'm telling you. So you better listen to me when I tell you about this." He took it in that context.

He agreed that he really should know about that. I said, "It's bad for you to be given advice on doing something without knowing the ramifications of it. Now you really need to know what the hell the outcome might be if you make that decision." So he would take it gracefully. But he would really get wild at times though. He knew he had to do something when I'd tell him about field issues. He'd say, "God almighty, that's going to cause a lot of problems. I've got a General out there who just doesn't want to do this." But anyway' it worked out pretty good.

Q: The politics of dealing with the Directors of Civil Works and the division engineers have got to be really a painful thing sometimes.

A: I got one general pretty mad at me. He would never speak to me again. Just because we had a disagreement over at the Rivers and Harbors Board one time. I just couldn't agree with what he was saying. He didn't like me to tell him something different apparently because he never would speak to me again.

Q: Well, just as long as they don't come in to be your boss.

A: Well, I was pretty sure this guy wasn't. I knew he wasn't as a matter of fact.

Q: Well, that's okay then. You don't have to worry too much about that.

A: Well, of course, I guess at the time it wouldn't have made too much difference anyway. If he had of come in, I would have retired.

Q: Who was that?

A: That was Tommy Sands.

Q: Oh, Tommy Sands. When he was down at LMVD [Lower Mississippi Valley Division]?

A: Yes. Nobody comes from LMVD to be the Director of Civil Works. At least, I had never heard of any of them who ever did.

Q: Well, they've got one up here now who is acting director, Art Williams.

A: Yes, that is a switch.

Q: But he's a different person. He is a very solid person.

A: Usually, when they put them down in LMVD, that is their last job before they retire.

Q: I don't think so in this guy's case. I think Art might have a pretty good shot at being the next Chief.

A: Well, that wasn't always the case for that type of thing. Let's see there was Rollins [Major General Andrew Rollins]--didn't he come in as deputy chief?

Q: Yes, he was deputy chief.

A: He was deputy chief after he had been division engineer.

Q: I'd like to begin by asking you if you have any additional thoughts about what we talked about last time?

A: Well, I don't know. We kind of jumped around from one subject to another. I guess you'll straighten that all out. But I don't know whether there will be duplication.

Margaret Petersen

Q: Well, that's one of the advantages when you get one of these texts back--you can take bits and pieces and move them around.

A: When I looked over a couple of things that might be of interest to you, one thing that I thought might be interesting was an article by Margaret Petersen, who was active in hydraulics throughout her career in the Corps. She is very active in ASCE, too. But she has an interesting perspective on the Corps and her whole career practically was in the Corps. She is now doing some teaching work. But she is still in ASCE.

This article was published in a book called Sons of *Martha* by the ASCE. Jay Frederick was the editor of it. He used to work for the Corps, too, in hydrology and hydraulics. He is also in the educational business now. But you can have that. I made a copy for you. There are some things in there that might be of interest and might give you a little background on some of the hydrology and hydraulics.

She was in on some of the early phases of hydraulics where they had to come up with new ideas in hydraulics, and develop new ways of doing things.

Q: As a matter of fact, in preparation for today's interview, I was looking at her book *River Engineering,* last night. So it's interesting that you bring her up.

A: Well, since she's one of the first females, or one of the early females anyway, in the *Corps* of Engineers, and she had a pretty good career I think.

Q: She must have been one of the very few with a 40-year career.

A: Oh, I don't know of any who had that long of a career with the Corps. But there's a lot. There were quite a few women that have been in the Corps. A lot of them are not in engineering, of course.

Q: That was pretty rare, wasn't it, in your days, if you go back and think about the '40s and the '50s?

A: There were no girls in an engineering course in my school. I remember when I got to work for the Bureau of Reclamation, there was one gal who was an architect. But we didn't have any female civil engineers in the Bureau of Reclamation. When I got into OCE, I hired the first female engineer in the H&H business. In OCE, they had never had one before. I don't think they have any now either. I'm pretty sure they don't. For a while we had Nancy Lopez, who went over to the Department of Interior. She has been over there with USGS for quite a while now.

Q: I met her when I first came to the Corps, and we were in some kind of program together on something. I forget what it was. But we did meet and talk. She was very impressive.

A: Well, I found that some of the early gals that I ran into in engineering all seem to be out to prove something. They've got to prove that they are better than the men, not just as good as the men. But since I've been over in private practice, I see they've got a lot of female engineers in various disciplines. There are as many or more women as there are in men in the office, I think, and professionals, too. So I don't have that same kind of opinion--I don't think they're nearly as concerned about having to prove that the women can do as much as the men nowadays because it is pretty obvious that they can.

Most of them don't have that over aggressive kind of a behavior that a lot of them had. I know the GS [U.S. Geological Survey] had some that were like that. They really had to get in there and assert themselves all the time. Even though when they really didn't need to, they would do it anyway.

People to Talk to in the H&H Field

Q: So that was more of a societal change that the Corps was undergoing while you were there?

A: I got a list of a few people you might want to talk to--it's far from a complete list or anything. Just the few people that stuck out in my mind that I might mention. Now we mentioned McClendon before from MRD who was very effective in this business. Another one, Al Harrison from the MRD office, who was more in hydraulics and not so much in hydrology, but he was in charge of both disciplines when he retired.

Q: Now they're both from MRD?

A: Right.

Q: But McClendon's still alive you say?

A: As far as I know. He didn't continue in engineering activities. I think he was so interested in rebuilding automobiles that he spent all his time working on rebuilding automobiles. But it's kind of interesting how some people change--I don't know I guess in all disciplines you find this.

Like Verle Farrell, who use to be in the Chief's office. He was Chief of Hydrology and Hydraulics for about a year when Al Cochran left. When they took away our Grade 16 for the head of the group, he decided that he might as well retire because he had such a profound interest in the bird dog business. He liked to judge and participate. He had his own valuable dogs that he took to these contests all over the country. He'd spend all his time doing that when he wasn't working in hydrology and hydraulics. He is still active in it.

Another one would be Bill Eckert, who was Roy Beard's follow-up as Director of HEC. He originated some of the HEC programs. Did the programming on HEC II and HEC V, and he has an interesting background in hydrology.

As far as the experimental station [Waterways Experiment Station], I think Henry Simmons--he is primarily hydraulics but what little hydrology they did, usually came under him, too. In Cold Regions [Cold Regions Research and Engineering Laboratory, CRREL], another person would be Gunther Frankenstein. Of course, there are a lot of people over in IWR who have had some background in hydrology and have dealt with some aspects of hydrology, dam safety, and risk analysis.

I was trying to think of people that were, at least during my time, prominent in some of the different offices. At LMVD, Bob Louque comes to mind. L-O-U-Q-U-E is how I think he spells his name. In the North Pacific Division, Dave Rockwood, and then in the Seattle District, Norm MacDonald. Norm was probably one of the top people in hydrology in the district offices. He was very competent.

Another one like that was Tom Riley in the Pittsburgh District. Those two fellows were in the business for years and years and years and knew just about everything you could. At NCD, Don Leonard. I don't know if he is still there or not. He got to be Chief of Engineering in NCD.

Then SWD, Terry Coombs, who is now, I think he's Chief of Engineering in Fort Worth or he has a different job in Fort Worth now. Then as I mentioned, Margaret Petersen would be a good one. Those are some of the people that have come to mind.

Q: Okay. Well, I'll pass those names on and see what they can--if they can find them, which they usually can.

A: Well, usually what happens if you go to the office that they worked in, somebody there usually has an address on them or has kept up with what they're doing.

Career Ladder in the H&H Field

Q: We'll try to track some of them down.

A: One of the things that we probably talked a little bit about last time was a career ladder in H&H. In the early days, it was tough to really keep people in the H&H discipline because the career ladder didn't look that good. About the best you could do was to be Chief of Hydrology or Hydrology and Hydraulics, or whatever they called the particular office in the district or in a division.

The highest grade anywhere in the country was a GS-14. There were a few 15's in the research business but not in the day-to-day work. A lot of the younger fellows, after they had worked in hydrology and hydraulics for a little while, they would move over into another discipline where they would have a better opportunity to get ahead.

Someone in hydraulic design might get over into structures, or someone in hydrology may move to planning so they would have a chance to get ahead. They knew if they stayed in hydrology and hydraulics, they would be typed and there was no opportunity for advancement.

Now there were a few people that got to be Chiefs of Engineering or Chiefs of Planning when they started off in hydrology. But it got so they were few and far between. Even in later years in my career, why it got so that in Engineering they just didn't feel that the people working in hydraulics and hydrology were as qualified for being Chief of Engineering as somebody that worked in geotech [geotechnical] or structures.

As a matter of fact, most Chiefs of Engineering felt that the Chief of Engineering should come from a Structures Branch. It's pure and simple, if you come in from any other role, why then you didn't belong as Chief of Engineering.

Q: I was going to say, the geotech guys I've talked to always felt that they were discriminated against.

A: Oh, they were.

Q: Just like you guys were?

A: The structural people had the top priority, and it didn't seem to make any difference whether the people had managerial capabilities or not, if they were well known for their structural capabilities, why they would get selected a lot of times. But that kind of changed, as planning took on a stronger role.

But in the early days, why structures was the only way to get to be the Chief of Engineering. Then, in later years, why they still had a policy--if you're going to be Chief of Engineering.or any other division, why you needed to have a broad background. They wanted you experienced in a lot of different areas. They would like to have you experienced in structures, geotech, hydrology, and hydraulics.

They even started a lot of programs where they would swap people around. They would trade the chief of one discipline with the chief of another one, even though they knew very little about the other discipline they were going to be in charge of. I think, by doing that, people got a lot better appreciation for all the problems and concerns with the other discipline. It helped them, I'm sure, to become Chief of Engineering.

But, if you didn't have that structural experience, it was tough to get to be a Chief of Engineering. Although there got to be to a point, as I think we mentioned before, that because the planning chiefs were so articulate and they would have preferred to be Chief of Engineering than Chief of Planning, when the job came open as Chief of Engineering, often the Chief of Planning moved right over to Chief of Engineering. They wanted that, they preferred that job to being Chief of Planning.

Q: Like you said before, that has always been seen as the job to have in the division or district, isn't it?

A: Yes, it has been in the past. I don't know whether that is going to continue. I don't even know that it does continue today, but it certainly did in the past because the Chief of

Engineering was always viewed as the guy who was suppose to be the most knowledgeable about the Corps of Engineers' activities. That prevailed when Lloyd [Duscha] came into Washington. He became the top civilian, as I mentioned before. Everybody looked up to him as having the choice spot in the Corps as far as a civilian was concerned. He was recognized world-wide because of that particular job.

But, anyway, getting on to this, how we finally got some improvement in the career ladder. We came up with a concept of a Water Control Management Branch within the division offices to not only handle the hydrology and hydraulics but primarily the big responsibility was operating all the reservoirs and taking care of all the management activities that went along with that. That was tough to sell but that finally got the blessing of the headquarters.

In most of the divisions that gave a Grade 15--there were several of them around the country now--people began to say, "Hey, if I stick in hydrology and hydraulics, I may get to be a 15 in division office." Well, that was the same grade as the Chief of Engineering in the District, so it looked pretty good. So there were more people that stuck with it, I think, after they found that there were opportunities.

There were a few divisions that never did adopt the job because Planning and even Engineering kind of objected to having it. Planning didn't want to have it if it wasn't going to be in planning. If it would have been in Planning, maybe they would have liked to have it there. But in Engineering, a lot of them didn't even push for it. They finally got them in most of the division offices.

Those positions have played a key role in a lot of the big water management problems we've had around country. They had a place to go to that really had some responsibility in that area.

Q: That's really one of those questions of professional jealousy more that anything else--the people in the Structures and Engineering Division just didn't concern themselves with your special discipline or they just didn't want to see your people rise up. But that's sort of self defeating though on their part to operate like that?

A: One of the things that made it very difficult for hydrology and hydraulics, there was no exact spot for it. The hydrology people did all kinds of work for planners to get the plans put together for feasibility reports. They needed all this hydrology in the planning.

Engineering not only needed the hydrology, but they needed the hydraulics and hydraulic design to go along with all the engineering studies that were being conducted. They had to have hydrology and hydraulics.

Then when you got over into the operations, the people who did the physical movement of the gates and so forth, they didn't really have any background on why they should change those gates and so forth, other than people would complain about what they were doing. But they got their direction from hydrology and hydraulics people who had the experience in doing all the studies to decide how you needed to operate those gates.

It was like serving three basic elements of the Corps. Yet you had to put them someplace? and where do you put them? It started off traditionally because they were in engineering to begin with and so was planning and everything. It was harder to take them out of engineering and put them in one other area when they were already in engineering. Of course, no division chief wants to lose any of his branches because he'll lose part of his responsibility and probably some of the justification for his own position.

It always was a constant problem [of] trying to decide who would handle that one. Let's see, it was the Los Angeles District. They even moved the people who were doing the water control management into the Operations Division. They took them out of the Hydrology and Hydraulics and put them in the Operations Division.

A fellow by the name of Tatum--you probably heard of him, I don't know. He has a hydraulic model, a routing procedure, named after him. He's done some individual things in terms of hydrology and hydraulics. Very active out in the Los Angeles District. But because it was important out there in operating some of those projects, they wanted the guy that knew the most about it, right in the Operations Division.

It worked. We didn't like it when they did that because it started fragmenting the capabilities of the discipline. I always thought that it would have been better to have hydrology and hydraulics in a separate group, so that they weren't directly under Chiefs of Planning or Chiefs of Engineering or Operations, any of them. Then they could provide a service for all of them and be impartial because when you're under one, it is very difficult to be impartial because your boss makes it almost impossible for you to be impartial.

Q: It's like a special staff office then?

A: Well, in a way we were a division in Civil Works there for awhile just before I retired. It was almost like that, except even though we were assigned to civil works, we were still kind of serving like I thought we should serve. Maybe it should have been, if not called a division maybe some special office or something and with a fairly high grade. Maybe not as high as the Chief of Engineering and Chief of Planning but at least have a pretty high grade so that it would have some recognition.

Throughout the years, there was always a lot of concern from the field offices about what hydrology and hydraulics people were doing. Even when you'd go to a conference and the headquarter's office, for example, would have a lot of comments on what a district had done on one of their reports. Things that really should be changed, and they became the subject of debates.

The people in the districts said, "Ah, we shouldn't change the district engineer or the Chief of Planning report. We can change all that later." But changing something later can be very traumatic sometimes if it is going to impact some Congressman's district. If the district engineer promises him a project and then you get it authorized and you can't build it because of changes in hydrology or hydraulics or any other changes later on, then he blows his top at the district engineer. The district engineer then might have a little trouble being a general.

But, anyway, politics always gets in the way of doing things impartially. But it just seemed to me if the hydrology and hydraulics element hadn't had to report directly to one of these other guys, they could be a lot more impartial in providing information.

Q: Did you or anyone else ever try to get that done in any of the districts or divisions?

A: Well, I don't know that it ever got anywhere. There were a lot of people who thought about it, thought it would be nice if they could do that but they never got any encouragement from anybody. So it was very difficult to move ahead. It was very difficult developing those Water Control Management Branches in the division offices. That was tough. But somehow Al got that started. He was able to get the first one or two going.

He'd keep putting pressure on all the Chiefs of Engineering in the division offices every time he talked to them about establishing a Water Control Center. His persistence paid off in a lot of ways, I think. It helped the organization a lot.

But, anyway, that gives you a little bit of a flavor for how they got some sort of a career ladder for the discipline.

Q: You must have been sort of the career manager then for hydrologists in the Corps in your position?

A: Bight, I was.

Professional Development Program for H&H

Q: Now I know there is a very sophisticated professional development program for scientists and engineers in the Corps. So when you were beginning, when you were planning a career for a hydrologists, did you have that in the 1960's? Were there enough schools producing hydrologists that you could get a pretty good selection for interns or trainees and enough post-graduate course work that you could train these people?

A: Well, as far as hydraulics was concerned, there has always been a good training resource in the private sector for hydraulics. Maybe not so much on dam design, but on other phases of hydraulics, but not as much in hydrology. We almost always had to depend on in-house training of some sort for hydrology background.

At one time, there was a lot of demand for the courses in HEC to be given to private people, other agencies and so forth. The Corps really didn't have the resources to train everybody in hydrology. So they started trying to get universities and private firms to teach some of these courses. It's been quite some time, there have been schools like Penn State and University of Texas, Colorado State, I think, are probably the ones.

But there are a lot of schools that have courses. Missouri School of Mines is another one, I think. There are a lot of them that have courses in hydrology and hydraulics both. Some of the people that worked for the Corps would go to work teaching or they would get a job with private industry someplace. They would start teaching a course on hydrology and hydraulics in the summer, usually between the major sessions. There were quite a few courses available that way. There are, I guess, plenty of opportunities now.

Then they have the program where the Corps would send you away to a graduate school. This got more attention, and they started sending a lot of people to graduate school. There were quite a few fellows--I guess some females probably got involved in that, too. I don't know of any of the females that did because there weren't enough of them, but some of them got to go away to school for a full graduate degree.

They helped others like myself by paying for the tuition for the courses in the evenings. You still went to work all the time, but your did your work on your own. But if they paid the tuition, then that was good help.

Q: Now that kind of thing is critical to the development of your people--to have training courses and that outside base of expertise. It also provided you with consultants, didn't it?

A: Oh yes. One of the key cornerstones of HEC, when it was founded, was the training aspect of it because, just like you were talking, there were limited resources available then and we wanted to be sure that people were trained and trained fairly consistently. If you have everybody trained in different offices, they've got a little different outlook on how the profession should be conducted or performed.

Another problem that used to give us real headaches was when some discipline within an organization would do hydrology and hydraulic studies without coordinating with the actual Hydrology and Hydraulics Branch. For example, a lot of times we would run into people doing relocation work. The people doing relocation work would think they had to do all the studies in-house.

They would do the geotech work, the hydrology and hydraulics, the structures, everything that they needed to do they'd try to do in-house in their own little branch. They wouldn't go out and get the assistance they should have. Sometimes they would be using antiquated things that were no longer in use. When all they had to do is walk down the hall and get all the help they needed. They just didn't seem to want to do that.

I was always concerned about the people that would do that. Planners doing their own hydrology. That bothered me, too. I wanted--at least when I got to be in a position where I had a little bit of control over what went on--to be sure that whenever there were any hydrology studies done, at least they would be coordinated with the main hydrology and hydraulics group.

I don't know that that was always done. But some of the people--well, like I mentioned before, a person trained in hydrology would transfer over to the planning division. He'd figure he knew as much or more about hydrology than the guy in the Hydrology Department, so he'd do his own hydrology. But things might have changed since he was in the hydrology business, so he may be a little obsolete in what he was doing and he wouldn't know it, if he started to do it on his own. I guess that's true in other disciplines. You see the same kind of thing happening.

Q: You're sort of fighting human nature in that area, I'd say.

A: Oh yes, you really are because a person [who] has some training in the area, he feels like he knows as much about it as the other person or he thinks he does, why should he go to him for help. He says, "I can do this myself." Well, not only that, I don't have to wait for it. If I call up the head of hydrology and ask him to do this study for me, he'll tell me, "Well, we'll put you in line. You'll get your study done three months from now," or something like that, and he wants it right now. So he says, "Well, I'll do it myself then."

Q: Get it done with?

A: Well, that happens a lot.

Q: When the H&H Branches or Sections were pretty fully developed in all the districts and divisions, about how many people did you have? Were you monitoring their professional development program in the career program?

A: Well, off hand it's a tough--there were so many--we had some surveys but I can't remember the numbers right off hand. Well, some of the offices had a pretty good staff and some of them a real small staff. But we had, how many district offices did we have?

Q: You had about 40 or so districts out there at that time.

A: About 40 districts. Well, just a rough guess of people in hydrology, there would have to be at least 200 of them or more. But from small offices, some offices only had a couple of people because they didn't do much. Others had big staffs and especially down in the southwest for awhile when they were building all those dams.

Then when you consider all the other people that work in hydraulic design and hydraulics and water control management and all that, numbers get a lot bigger than that. But just pure and simple hydrology, probably as a minimum, 200. That would be just a rough guess because I don't remember the numbers--we had to do that once in a while but the figures don't stick in my mind.

Computers

Q: Okay, that's fair. You were in from 1958 to 1985. You went in there about the time that computers were coming into engineering work in good quantities. How much did those computers change your work in H&H at OCE and throughout the Corps in those years?

A: Well, to tell you the truth, it didn't really change the work much in OCE. Where it did change the work was out in the production area out in the districts where they were doing a lot of studies. Then HEC was probably the most prominent organization in the Corps for developing computer capability when it first came along. They had converted hydrology and hydraulics computations to computer use quite a bit before some of the other disciplines got their stuff converted over. Now they didn't do so much new development in hydrology and hydraulics. I mean, like new theories or things like that, but they took all the existing capabilities and converted it over to computer use.

We used to have a lot of discussions about how they should develop that--the use of the computer. Some of the district offices were almost as prolific as HEC was in coming out with computer programs. Take, for example, Rock Island District, a fellow named Nanda from the Rock Island District--I can't even remember his first name. Maybe that's his first name. He is an Indian. He was really competent in hydrology and in computer programming. He liked developing small computer programs that he could hook together. HEC got more and more into big programs that worked so you could do a batch load. Well, back in those days, in the early days, they did everything in batch load. You had to load this thing up on a big computer and then wait in line to get your stuff. Nowadays, they have PCs [personal computers], of course, and you don't have to worry about waiting in line, you can just go ahead and do your studies.

But you would write up your program and your input data and put it on cards and give them to whoever was running the big computer. So you really didn't get to run the computer yourself, you just gave them the cards and they ran the computer. Except in places like HEC, where they got access to some of the big computers, and they rented space on some of the Lawrence Laboratory [computers], I think, and some of the other big places where they got the use of some really sophisticated computers.

I used to argue with HEC about putting together large package programs where you would provide all the input data in one run. The data would go in one end and out the other end would come all this information and results on what you needed to know about the project in order to design it without anything in between. You didn't get any outputs in between.

Now the programs were designed so that you probably could get access to intermediate stages of the computation, but that's not really the way it was set up to run. You just put it in there, and you got the answers out--that's what the planning people liked because they didn't want to fool around with the intermediate stages. My argument, of course, was, "Hey, how do you know something didn't go wrong in there." You may not even be able to tell in your answer whether it's reasonably right or wrong if you haven't checked all these different steps as you go along the way.

So the argument I use to get from Beard and Jay Frederick and some of the others that were in the early end of that computer business was, "Hey, you can do all kinds of 'what if' things with computers that you couldn't do before. " So, if you really wonder if a person can get better trained with a computer than they could by doing it by hand, they can try out different things. If this doesn't work, try something else.

But I still had reservations about that. I felt that too many people, because they could stick in data and get an answer, they didn't have to know anything about the theoretical background of where all this came about. What is a unit hydrograph, what does it do? How do you route floods through reservoirs and stuff like that? What are the procedures in backwater studies? What are the formulas and so forth that go into the concepts that.

They get wrong answers, and they don't know it. All they know is that they got the program to run, and they got an answer and they go ahead and apply it and also it kind of avoided checking. They would just assume the computer is right. Where years ago when they first started, when I first started, everything had to be checked. You never send anything ahead without [checking]--if you had a computation sheet, it always had to be computed by and checked by someone. You just never sent anything without checking.

Well, that kind of went by the wayside when the computers come along. You probably still need that sort of thing though. I mean not necessarily checking every number in there, but to be sure that whoever put the program together and the input data, knew what they were doing.

Just to give you an example of one process that can get screwed up pretty easily and that's flood frequency, flood flow frequency analysis. Even though they come up with Bulletin 17B, which was put together by the interagency committee on hydrology, subcommittee on hydrology, the procedure is fairly straightforward and it's not real simple but it's straightforward and anybody can use it. But the problem is the data that goes into the system.

What it's supposed to handle is peak flow, annual peak flows, for example, on a river at a particular gauging station. But these peak flows are supposed to be unaffected by man. No reservoirs in the watershed, no diversion projects, no ice jams, or anything like that.

If you take the data published by the GS [USGS] in their annual reports and just plug it into the PC program, we can get a nice answer. The GS has arrangements, codes in there, that will tell you if the data is affected by something, if there is a reservoir upstream or something like that. But if people don't pay any attention to that, just use the data that is published, they can get some pretty bad answers.

They need to go back in and look at any of those answers or any of those floods that have been impacted by ice jam or by regulation of a reservoir or something like that, to be sure that they're using homogenous data. Not many people do that if they are not trained in the discipline. They don't realize they even have to do that. So that's where you can get into trouble with computers--even though I really didn't get into doing the actual computer work myself until after I retired from the Corps. I never had time to do computer analysis. It takes so much time.

I used to get after some of our reviewers out in the division offices because they got so enamored with computerizing and doing their own types of programming that they would forget about the fact that they were supposed to be reviewing the district reports. Not doing the work themselves but actually reviewing them and telling the district what they needed to revise and do over.

That's a tendency for people who get started to use computers, to get fascinated by them and addicted to them, and they forget all about doing anything else.

Q: Gee, if it can do this, maybe it could do that.

A: Oh yes, it's a great tool for "what ifs". You say, "Well, this is a good answer maybe, but what if I did this, maybe I'll get a better answer." You have a hard time quitting.

We had a guy in hydraulics back in Garrison who wanted to keep improving on his answer all the time. We could never get him to stop studying. He worked on the same level that I did at the time. But I use to tell him, I'd say, "Adolph, you've got this answer so close now how can you worry about getting any closer? You know that, or your answer isn't any better than that." "Yes, but if I improve this channel a little bit here I could probably get the water surface another hundredth of a foot lower." I said, "Well, Adolph you don't need to do that, it's not that important. Forget it and move on to another project."

But he wanted perfection and strived for it all the time. He was a real math genius. He was from Europe, I've forgotten which country he was from now. But he used to tell me how the European education was so different than the American. He says, "They don't teach you to really think in Europe." He says, "They taught you all the theory, and you learned a lot of complicated formula and all that kind of stuff." But he said, "They don't really teach you how to analyze problems and to make up your own procedures and that sort of thing." He said, "If you had things that were laid out, this is the way you did it and didn't try to think if there was a better way to do it. "

So he said he liked the education his daughters were getting. It was better than his education. He says, "Even though I've got a lot of math and that stuff, "I still have problems with just making the right judgments on a lot of things. " That was interesting to find out that a guy would have that own self-criticism.

Q: Now that's an important step in anyone's education--to be able to criticize oneself.

A: Well, I was thinking about this book that was put together here.

Floodplain Management

Q: The book by Jamie and Dorothy Moore *The Army Corps of Engineers and the Evolution of Federal Floodplain Management Policy? You* wanted to talk about H&H's activities in floodplain management?

A: There are new programs in the agency. You asked me before how did the Corps respond from an H&H point of view to these new programs. Did they jump into them enthusiastically or drag their feet, that sort of thing. Well, it has been my experience that the Corps is very conservative on taking on new projects or new responsibilities. They go in very slowly--gradually, they'll get there but it takes them awhile. They just don't want to rush into something new, which is just the opposite point of view of the Department of Interior. If they even have an inkling that they've got some possibility for a new responsibility, they jump right in there and go full bore. They don't wait like the Corps does.

The Corps wants to be very sure that this is what Congress wants and very sure this is what the Administration wants before they really charge. A good example of it was when they got started in the floodplain management business, and the flood insurance program kind of went hand in hand. Al Cochran had really been interested in the floodplain

management. Since about nine tenths of the work in floodplain managementwas H&H--was doing H&H studies and then writing a report on floodplain information, he could have probably taken over that responsibility very easy. But he just didn't seem to want it. He was very reluctant about it. He would say, "Well, that's a different program than our traditional H&H." He wasn't all that enthusiastic about getting involved in it.

I know I kind of got assigned to work with the people in floodplain management. Whatever coordination was done, Al didn't even seem to want to be involved in it much. So that I did pretty nearly all the coordination. I went to some of the first meetings they had out in the field and so forth. I'd review the reports and make comments on the reports prepared by the field offices as part of my job.

But headquarters didn't really have much of a role in it because the districts did their own thing, really, in the floodplain information studies. They didn't have to be approved by headquarters, except the first few that came out to find out if they were doing things consistently.

James E. Goddard

But when they got [James E.] Goddard on special assignment from TVA [Tennessee Valley Authority]--1 don't recall whether he had just came over from TVA or whether he had resigned or whether he had already left TVA then. But he came to the Corps and he was going to make floodplain management the theme for the Corps. He was going to convert the Corps from a structural agency to non-structural floodplain management activities, or at least that seemed to be his goal.

He would come over and argue with Al about things that needed to be done. Since I was sitting very close to Al, I heard all these conversations that went back and forth. Goddard would talk for awhile and Al would be sitting there, and he wouldn't be saying anything--they were both real strong, aggressive type people. One of them would talk for awhile and the other one wouldn't hear a word he said--it was pretty obvious because as soon as he got a chance to say something, he'd take off and go in just the opposite direction.

But, obviously they didn't hear what the other one said. They both had their pitch that they were going to make, and they weren't listening at all so that they never did seem to get together on anything. They were always battling about what probably should be done and how it should be done.

To give you an example, they hired this guy, Goddard, to do a job in the Corps, but they didn't put much supervision on him. They let hirn go ahead and do his own thing and he

got going. They set up a big meeting out in Chicago, and I went to that meeting. But at that meeting, Goddard was going to present the Corps' floodplain management program for them. Fortunately, let's see was it Tofani? I think it was Tofani that went to the meeting. He decided maybe--or maybe it was Reisler. I don't know, one of the two of them went to the meeting. But, I think it was Tofani.

I had told them before when I found out what Goddard was going to do out there that I thought it would be a good idea if someone from their office went to the meeting. I said, "Because he is talking to the whole country out there, and you guys better be there to see what he says and make sure that he's saying exactly what you want him to say. " So I don't know whether my talking to them had anything to do with it or not, but they went. So I'm pretty sure it was Tofani that went.

But, anyway, Goddard had this big program all laid out. He'd get up and start talking. He'd say, "Well, now this is what we're going to do. We're going to do this, this and this " He'd get about two-thirds through and Tofani would get up and say, "No, we're not going to do that." Goddard would look at him, "What do you mean we're not going to do that?" Tofani would say, "We don't have the authority to do that. Besides our policy wouldn't allow us to do that even if we did have the authority. " Everything, practically, Goddard said we were going to do, Tofani would get up and say, "No, we're not going to do that. " It was the damnedest fiasco you ever saw.

There hadn't been any coordination between them before they went out to this meeting and here were all these people from the district offices expecting guidance on the floodplain information program. All they were getting were conflicts. It was really a sad deal, I think. It was partially due to the fact that they didn't find out ahead of time what it was Goddard was going to present. I think they just confused everybody rather than helped them.

But after that then they started paying attention to what they were doing and they got the ball rolling. It was just kind of an example of how people didn't have much interest in it when they first started so they assigned it to somebody that didn't even know the Corps' policies and what the Corps wouldn't do under certain circumstances. He was going by his experience with TVA and he assumed the Corps could do everything that TVA did. He was going to have the Corps do all kinds of one-on-one help and things like that, which the Corps didn't do in those days and they still don't do much of it. I don't think they're doing it at all now either.

But, anyway, it was a sad situation to begin with. It got going eventually, but it just took time to overcome all those hurdles. After awhile, the floodplain management people got

involved in the flood insurance working with HUD [Housing and Urban Development]. We did some of that, too, because flood insurance people didn't have much experience in hydrology and hydraulics. They had a few people but very few. They weren't really tasked to do technical studies. They were expected to use the advice and counsel of other agencies that had the technical capability.

So they called on the Corps for a lot of the assistance. They ended up making up their own minds, of course, what they were going to do on things. But they would ask us and often I got involved in it because I had been close to the program. There would be discussions on levee design and all kinds of things like that--expected probability and the statistical array--and that's been a controversial subject between the two agencies for a long time--about whether you use expected probability or not, and it still is. Right now, it's raising it's head again.

But that concept was that, given that you come out with your computed probability based on the record you have, there is a statistical technique for adjusting the results of that analysis based on the length of your record. The length of record is a measure of the accuracy of the results. If you get a gauge with a lot of years of record, you automatically assume that that is better than the gauge with a shorter period of record. That may not always be true, but over the long run that's true, of course.

So the Corps' concept was we use expected probability because if we get new data and it changes, it's more likely to change the frequency curve one way than the other way. It's almost assured that if you get enough additional data, the curve is going to move in one direction. The Corps uses that because they build projects and they do economic analysis based on what is going to happen in the future.

They try to apply all the things that they can reasonably estimate in the future to their analysis. When they design levees, the economics, the design level, and all that sort of thing is based on the expected probability. Even though the flood insurance people agreed that that was a good concept, they had some practical considerations that they couldn't let technical things get in the way of. That was, if you have people living in the floodplain, how do you define t.he floodplain.

If you use information that may or may not change the answer, it's a question about whether it is going to change the answer or not, they wouldn't be treating these people fairly. Because if they say, "We moved the floodplain way out here because we think that when we get new, more information, it's going to move out there. " The people would say, "Well, it's not there yet so why am I penalized, I can't build in this floodplain on my land because you've said the floodplain is here, I can't build anything. [You've] limited use of that land, you've restricted my use, and you don't have evidence that good to prove

that it is going to be out there someday. You know it may not happen for many years and I've lost the use of my land."

The flood insurance had a good rationale for saying, "Well, we're not going to use anything that we don't know today--pretty darn sure of today. If something new comes up and changes, we'll change the floodplain when that happens." That's really not all that difficult to do, you just change the line on a map although it may have some strong impacts on people. It's not hard to do.

Whereas, if you discover that you made a wrong frequency analysis in designing a levee, you can't go back and tear part of the levee down because you thought it was too high or build it up higher either because you have to go through an incremental, economic justification analysis to get any addition on that levee which is almost impossible to get.

Making changes on a structural project are infinitely more difficult than making changes in an information report or a flood insurance report. That's really the basic difference in the two concepts and why they don't agree. Well, the flood insurance hasn't been as strong at trying to get the Corps to change as the Corps has been trying to get FEMA [Federal Emergency Management Agency] to change and to use expected probability.

The Corps, when I was with the Corps, we always tried to get them to do that because we said, "Well, in the long run if you do that you'll be saving yourself money because you won't have to change the floodplain and you'll be getting returns on your money that are more closer to the actuarial rate."

But FEMA says, "Well, it's not hard for us to change the rates either. If we're not getting the kind of money we need, why we'll just raise the rates." That's what they've done. They didn't really do a hard economic appraisal on what they should do to change their rates and so forth. They just said, "Hey, we're losing money. We'll increase the rates until we quit losing money." That's the way they've done it so far.

Q: That's a very practical approach, isn't it?

A: Well, it's a simplistic approach and it works politically, too, I guess. It's a lot easier to put your books before the public and say, "Look, we're losing money. We've got to charge you more." Then it is to say, "Hey, we may lose money if we don't raise our rates. We think we might." People don't want to buy that, they'll buy the other concept. So, anyway, we get into those kind of differences.

Then it's hard for some people to understand that there is a reasonable answer for why they're doing what they're doing. It's different than what we're doing but it's still okay. General Kelly [Major General Patrick J. Kelly, Director of Civil Works, 1989-91] and FEMA had a meeting a while back to talk about this. They kind of agreed they would both go their own way like they have been in the past.

Right now I'm looking at something that the Corps put together, talking about this difference. Somehow FEMA is going to have to agree to it before they put it out, I'm sure. But it was written in a kind of a way that made FEMA look bad. Makes it sound like the Corps is right and FEMA is wrong. It should be written making both of them right and not trying to infer that one is smarter than the other or anything like that.

It's not going to sell. Whoever wrote it wasn't thinking about that, I don't believe, when they put it'together. Either that or they just didn't recognize the implications of what they said. But it will be changed I'm sure.

Q: The whole subject of floodplain management, you made the point that that was something that was relatively new to the Corps, so new that they brought a consultant in. How, over time, did the Corps acclimate itself to that responsibility or did it?

A: Well, you see, through the years the floodplain management in the planning side of the house, the feasibility reports and so forth, they do go into the full scale review of different options for reducing future flood damages. But the actual group that Jerry Peterson is in charge of right now, there was a time when they weren't sure where they were going or what they were going to do because the need for the flood information reports, which they were producing, was kind of going out of business because FEMA was preparing all the flood insurance studies.

FEMA was doing the thing that the Corps had started off doing in flood information reports. As a matter of fact, a lot of these flood information reports that the Corps did early were almost like putting a new cover on them and making them a flood insurance report. I mean as far as the technical work is concerned, they didn't really have to redo it. They just used what was in there.

So after the flood insurance program got real active and it was obvious that FIA [Flood Insurance Administration] was going to do all these reports, then there wasn't really a role so much for the Corps anymore. So there was a little question about what their role was. So they've been getting into other areas that they didn't do before. They've done studies on evacuation planning from communities and things like that that they had never done before. Certainly a worthwhile effort.

But it did change when the flood insurance program became strong. Here you got into this other problem of using expected probability. The Corps people didn't want to do a FEMA study on their contract--FEMA studies, all their studies are done by study contractors. The Corps does the studies. The USGS does some of them, the SCS does some of them, and then a lot of them are done by private contractors.

But the Corps wanted to use expected probability in their studies. FIA says, "No way. If you're going to work for us, you're going to do things the way we want it done." It was a tough job. I know Jerry [Peterson] used to have a real battle with a lot of the districts. He'd come see me, "Hey, what can I do to get these people." I'd have to call up and talk to them and say, "Hey, if you guys are going to get this job and do stuff for FIA, you've got to do it the way they want it done. You don't necessarily have to endorse it. You just do it the way they want it done. Just say that you did it right as far as it goes." But because you would do it differently doesn't mean that what they want isn't okay for their purpose.

Well, FEMA even went so far as having the National Academy of Sciences review that expected probability concept. They came up with the conclusion that there was no statistical reason why FEMA should use it in their program, in their flood insurance program. But, anyway, they said it was a worthwhile concept, there just wasn't any rational way of saying it had to be used in a flood insurance program.

Even to this date a lot of the problems that FEMA has with the Corps are concepts of the Corps people about FEMA's capability. FEMA has had technical evaluation contractors and that's who I'm working for, one of those right now, who review all the work of the study contractors. They try to decide whether there are any problems with what the study contractors have done.

Of course, whatever they come up with for a flood insurance study is always subject to challenge by the community or by other people. So if things don't come out the way the community wanted them to or think they should, they can always challenge it or get their own consultants or do their own work and try to prove that FEMA didn't come up with the best answer. A lot of times FEMA changes answers when thev review the other work and say, "Well, that's better than what we had done and we'll make a change for you."

Occasionally it gets to be a real tough battle when the political business gets involved. The community will get their congressman or their senator to say, "Hey, why? This area shouldn't be in the floodplain." The congressman gets involved, and he fusses at FEMA because they're not doing what the community wants. So FEMA has a tough time dealing with the senator or congressman.

Anyway, that's a little of the background on some of the problems we had with FEMA and the insurance prograrn. Another agency that had a lot of dealings with the Corps was the USGS. The USGS used to, and still does, do an awful lot of the stream gauging that the Corps paid for. That got to be a little bit of a controversy for awhile there because, as I mentioned, the GS is very eager to promote themselves as being something, not just a data collection agency, but as a source of technical knowledge, of all types of technical knowledge.

Through the years, I served on the Inter-agency Advisory committee for the USGS, this was supposed to be an independent committee that gave advice to the USGS on what the other agencies thought they should be doing. There are Federal laws that established the USGS and what their role was going to be.

Our position in the Corps was, "Well, your primary goal was data collection as far as we're concerned. So we would like to see you spend as much money as possible on data collection because there is not enough money to go around to do all the data collection that needs to be done." The GS was trying to get away from this role of being strictly data collection and wanted to have a lot of good technical experts on their staff that did studies as well as just collect data. So they gradually started getting various expertise.

Ground Water Studies and the United States Geological Service (USGS)

Now, one area that I felt very strongly needed expertise was ground water because nobody else was doing it. One area where the Corps did very little work, primarily because we weren't involved in the water supply too much--only so far as reservoirs are involved. So we didn't do a lot of ground water studies. When we needed to know something about ground water, we wanted somebody else to be able to provide that guidance to us. The GS did that through the years. They developed their ground water expertise. Nobody seemed to have any difficulty with that.

A lot of the private communities needed data like that in trying to decide where they were going to get their water supply, ground water, or if there wasn't any ground water, then they would have to go to a surface water source. But they were able to get information from GS on available ground water, yield, and all so forth.

Periodically I'd get requests from the GS asking me what kind of technical expertise would you like us to be doing work on so that we can help the other agencies with our technical expertise? I'd write back and tell them, "You don't need to do any technical work in surface water. We'll do that ourselves. You just keep the data coming, and we'll do our

own technical analyses." They didn't like that kind of an answer, of course, because it was in a way putting them down as far as the technical part.

I don't know how many people, but I know a lot of people, felt that their primary role should be in the data collection, and it still is today. But I had my only significant confrontation, I think, with another agency [with USGS]--somebody on my own level from another agency. But it was one of the fellows from the GS--we had a problem with funds. We were putting out a lot of money for data collection before trying to figure out how we could cut back on some of those funds. Just spending too much money, they said.

One of the districts, Rock Island District, decided that they should do their own data collection. That they could do it cheaper than to have the USGS do it. There got to be a big controversy about whether they should do that or not, and the GS objected strongly to it. But the district felt real strongly that they wanted to do it themselves. It finally got resolved where they--the GS--continued to do it, I believe, was the final outcome.

But at that same time, it came up that the operations people were hard-pressed for money. They said, 'We've got to cut back on some of these areas. What can we do in the data collection area?" Well, the Corps was paying for data collection, but the GS was doing it.

So we got people from the GS to come over and talk about what we could do to cut back on funds. We need data, but we can't be as generous with the money we've had in the past. What are some of your suggestions? They said, "Well, there are things you can do. We can still get the data, but we don't need to process the data as fancy as we do when we put it in published reports. We could go out and still get the data and you would just use it. You'd process it yourself or use it as you needed it. But you wouldn't archive it in the nice, neat manner that we do it. That would save you so much--20 percent or something like that." Now it wouldn't get into the GS records because it wouldn't be archived in the proper manner and the established procedure.

So headquarters level decided, based on this advice from the GS, that we could still do that sort of thing. I signed a letter to the field offices saying that when you review your annual budget for next year, we know that you're strapped for money, why [not] consider this concept of getting the data but not processing it as refined as it has been in the past.

The head of hydrology over in GS hadn't really been involved in these discussions, it was the people that worked for him. He saw that letter with my name on it, and he looked at it and he blew his stack I guess. He called me up, and he called me every name in the

book. How I was destroying the data collection program, the government's agency program, and all this--he just run me over the coals.

He wouldn't even listen to me when I told him, "Well, we're strapped for money. We've got to do what we can. Besides, this wasn't done unilaterally. Your people have been over here for four or five different meetings talking about it. It's nothing new to your staff. Maybe you haven't been told about it but everybody that has been over here knew about it." It's nothing new, but I couldn't even get a word in edge wise with him.

But then I fmally said, "Well, if that's the way you feel about it, then we'll just let it go". He was so incensed that he called up the Weather Service and tried to get my counterpart over there to protest what we were planning on doing also. He wouldn't do it. So he tried to get him fired. I mean he was the GS guy who had been switching funds from data collection to technical analysis. So he was raising hell with me because I was going to take some of the money away from data collection. So it was just very difficult for me to swallow.

Q: So he was really playing games?

A: Well, he was putting it all on the fact that they weren't going to be able to get as much data in the future, it was all going to be my fault. It wasn't his fault, it was my fault. But, anyway, I let it go knowing that GS was going to come over, I assumed, after listening to him, that there would be a plea from them to our generals anyway. Right away I went up and talked to General Kern [Brigadier General Richard S. Kern]. He was a Deputy Director of Civil Works at the time (1980-81). I said, "Well, here is what happened." I gave him all the background on it. I said, "They're going to be over here for sure. So you ought to be aware of it and pass the word on up the line so that you're prepared for them when it happens."

Well, they came over eventually, but they had the Chief of Hydrology muzzled. They weren't going to let him talk because I told them ahead of time, "When you come over here, if you let him talk to one of these generals like he talked to me, you probably won't have any more funds from the Corps of Engineers for stream gauging."

Anyway, they kind of muzzled him when they came over. So he didn't get to say very much. But he did say enough to aggravate the general, so that they weren't too happy with him either.

Q: About what time was that. What year, do you remember?

A: Oh, I'd say that wasn't too long before I retired. Maybe a couple of years before I retired, in that time frame. But it was a time when funds were tough for operating the reservoirs, and that was where a big chunk of our money was going. We figured, well, if we don't attack that chunk, why it's not going to do much good to try some of the others.

We wanted to have our data archived, too, just like everybody else, but if we were going to have to pay for all of it, maybe it wasn't going to get done. It would be available in our offices, but just not in the same format that it was with the GS. It is one of those things you feel bad about having to do, but I felt pretty bad when I would go to these annual programs of the USGS and see them sticking more and more money into technical analysis and less and less into data collection.

I had some other troublesome experiences with them. I got along with the people in the GS very good. I had a lot of really good friends over there. But every once in awhile, I'd get put out with them about their aggressive nature for doing things because they weren't slow like we were when they would try to develop a new program or doing something new. Another example of their aggressiveness was in the water quality area. We were kind of slow working into the water quality business, but not the GS.

They had two advisory committees. One was a Federal advisory committee and the other was a non-Federal advisory committee. The only people on the non-Federal advisory committee were from universities, states, and communities. There were no other Federal agencies represented.

So what the GS presented to them was not always the same thing they presented to the Federal agencies. The GS would present the Federal agencies with their programs, and what they were planning to do. But the thing that kind of griped me, well, a lot of times, what we in the Federal community got from the GS was something that they were already committed to. It wasn't something that we could change. There was no way we were going to get a change because it had already been done.

But when they worked with the non-Federal sector, that committee, they would present proposals to them for what the GS might be doing and find out how they reacted to those. Obviously, if you go to people who are looking for information and somebody offers to go out and get it for you and then don't charge you anything for it, you're going to say, "Yes, we want that." Hell, they'd take that as a mandate for doing that particular work. Well, that's what they did with this water quality thing, and it ticked me off for some time afterwards.

But they went to them and asked them, "Hey, don't you think it will be good if somebody really analyzed a watershed, the whole watershed, to find out what you can do to manage the water quality and make sure that it doesn't get bad by storage in reservoirs or by pollutants, sort of look at the whole thing and not just one piece at a time." Well hell, all the people said, "Yes." Every one of them said, "Yeah, that would be great."

Well, the GS went ahead and went to Congress and said, "Hey, we got a mandate to go ahead and do this sort of thing." But they never even mentioned to the Federal committee that they wanted to do this sort of thing. So, somehow they got money assigned to do this sort of analysis.

The first I found out about it was I got calls from people in the Corps field offices asking me what these guys in the GS were doing coming in and asking about reservoir operation rules and talking about modifying the water control management plans of the Corps. I said, "I don't even know what the hell is going on." That's the first I found out about it. They would go to our offices and find out how the reservoirs were being regulated.

Then they were going to take those water control plans and see what they could do to modify them to improve water quality. They went out and hired a bunch of experts, people from universities, who were really smart guys with this sort of studies. They had this whole program going. It was on the Willamette River [in Oregon], I think, their first study.

But, anyway, when I found out about that I about blew my gasket. Here are these people out there going to tell us how we're going to regulate our reservoirs, and they haven't even talked to me about it or even told me they were going to interview our people. The next time we had a meeting, I got all over them about them. They said, "Oh, no, we thought you knew all about it." How were we suppose to know?

But they never apologized or anything, they just went on their merry way and they went on and did other watersheds. Well, obviously, after you've assembled a group of experts like that, hired them and trained them to do the kind of work you want done, you're going to find more work for them or fire them all. So it was obvious that they went ahead and did more studies. But I would have rather seen that money gone to data collection.

I'm not arguing that what they did weren't good studies. It was just that I don't think they would have gotten a vote of confidence from the Federal committee that they got from a non-Federal committee. Because the other Federal committees would say, "Yes, it would be good to do that but it ought to be an interagency effort, not a USGS effort, and use the capabilities of the other Federal agencies, particularly reservoir reservation like the Corps' projects and the Bureau's projects."

The GS weren't experts in water control management. They hadn't even asked us into the thing until they got the go ahead on the project. So that kind of thing really irked me. But, as I say, individually I have nothing but the best of feelings about all of my relationships with the GS.

The Bureau of Reclamation and the Soil Conservation Service (SCS)

Q: Well, if you had problems with GS, you also dealt with other Federal agencies. You've said Interior was very aggressive. What about the Department of Agriculture and the Soil Conservation Service? How were they to deal with? They must have had some significant flood and water quality issues to deal with.

A: I'd say our major differences probably with both the Bureau of Reclamation and the SCS are when communities or state organizations would want flood control projects and they would try to play one agency against another really. They'd go to one agency then they'd go to the other agency, and they'd try to get the Bureau to study a project for them or they get the Corps to study a project for them or get SCS to do work for them. There were many examples through my career where one agency had started doing an investigation for a particular watershed, and that ended up [with] another agency taking over the project.

I remember one in particular. When I was doing my paper on water supply at Catholic University, I was checking out a lot of things. One of the projects down in the southwest, I've forgotten the name of it right now, but the Bureau of Reclamation had studied it for irrigation. They had added some flood control, which the Corps had developed for them, the benefits for it. But they couldn't come up with an economically justified project, so they dropped it.

The Corps, at that time, was able to take benefits for water quality. Now I don't know just why the Bureau didn't have that option then, but apparently they didn't have that option. So the Corps, by adding water quality as a purpose, was able to come up with enough benefits to make an economically justified project out of it. There was some water supply on that project, too, which was a part of several purposes. When the Bureau studied it, they couldn't make it economically feasible but the Corps was able to because they handled the additional benefits.

There was another problem, not just with the Bureau of Reclamation and the SCS on the design procedures, because the Corps was designing all their projects for the probable

maximum flood. Although the SCS said they were designing theirs for the probable maximum flood, they didn't have any freeboard. So they could build a project cheaper than the Corps could because they didn't have that extra 3-5 feet of freeboard on the top, which is quite an additional expense. So they might be able to design and build a project cheaper than the Corps could with a little less design criteria.

That was probably one of the biggest areas of contention. We were having the same problem as I had told you last time with the Bureau about their analysis for a probable maximum flood--coming up with a lot smaller flood than the Corps. So that through the years was a big problem, but we got that straightened out.

When we went into the dam safety of non-Federal dams [program], all of the dams that the SCS build, or practically all of them, there are a few but most all of them, they turn them over to a local interest. Some conservation district or something that takes care of them and operates them after the SCS builds them.

So they were all non-Federal dams in a sense. They all had to be investigated by the Corps. When the Corps looked at them, they said, "They're not up to the normal design standards." If they don't have freeboard on them, that was our first approach to it. Rather than have all of these SCS projects come under the blanket of disapproval because they didn't have any freeboard on them, we finally compromised with the SCS and said, "Well, we'll argue that since your dams are small that you don't need freeboard as bad as the Corps does on its projects." It wasn't a very good justification but otherwise all of them would have had to be listed as not being up to par. We didn't want to make the SCS look bad.

So they just politically agreed that as long as they were designed for the probable maximum flood, even if they didn't have freeboard on them, we would accept them as being up to standard.

Q: Did that kind of criticism lead them to make any changes in their design criteria?

A: Not the SCS, no.

Q: Still no freeboard?

A: Well, they have a different concept of design. They have a design flood that takes care of the flood storage. Then they have what they call the spillway flood or something like that. It's the probable maximum flood, and they make their spillway big enough so that

they route that flood through, the probable maximum flood, it comes up to the top of the dam. Then they don't have freeboard for wave action or anything like that, which the Corps does. But that's their policy.

I guess they've had a lot of their dams over top, and they haven't failed. They have waves washing over the top, well, there's a few of them that fail but not very many. So they feel justified in not having to put freeboard on.

Q: What would be the normal size of a Soil Conservation Service dam versus a Corps' dam?

A: Well, it's governed more by drainage area. They have a limited, forgotten what their acreage is now, but the size of the watershed is what governs where they do their studies. They're suppose to do their studies in smaller watersheds and rural areas of course.

Q: So they're not really very big.

A: No, they're not really very big because the watersheds are usually not that big. But both of us get involved in doing some urban dams occasionally.

Section 221 Agreements

Q: How much of a different problem does that inject into your work when you go to an urban area?

A: Well, when we're working in an urban area, sometimes a flood control reservoir is used as a means of protection in lieu of a levee. You build a local flood protection reservoir. But it gets a little controversial when it comes to building reservoirs. Whether they have a Federal interest is kind of a ticklish subject in the Corps of Engineers--what is a Federal interest?

Anyway, if you build a small reservoir and the beneficiaries [are] not very widespread, they're all local, then it becomes a little questionable if there is a Federal interest there or not.

But there have been some small urban reservoirs built by the Corps. We had a strange one up in Montana--it is Havre, one of those communities in northern Montana. The Corps built them a flood protection dam, small dam for flood protection with a small gated outlet

works on it, but no storage for anything but flood control. It's suppose to be kept empty all the time except for storing floods.

Well, they went up there for the annual inspection one time and found that the community had closed the gate on the outlet works and filled up the reservoir with water and they were using it for recreation. Everybody was swimming and boating and having a big time, and there was no storage for control of floods. Obviously, the community didn't understand how the project worked or were not paying any attention. They just thought, "Well, this would be nice to fill it up for water and use it for recreation." So they did.

Q: Now, in a case like that, they have to empty that thing out, don't they?

A: Well, you see the Corps has a limited authority on what they can force the local community to do. They write them a letter and tell them that they're not in compliance with the rules and regulations for the way this project is supposed to operate. If they don't take care of it, they write them a letter. They have at least an annual inspection where they look at the project and check to make sure that it's being taken care of. Then they write them a letter protesting things that haven't been done.

Many years ago, they didn't really have any legal authority to make this community comply with those requests, other than the fact that the Corps would say, "Well, if you ever need any other things from the Corps, why don't come looking to us because you're not going to get them because we know from experience you don't cooperate."

It's been a few years back, they came up with these Section 221 agreements where the community has to sign off and it's a legal binding obligation where they agree to do all the things that the Corps says need to be done to operate and maintain this project. If they don't do them, why the Corps can force them through the courts to comply with the requirements. But I don't know that the Corps is--and they have yet to have their first case where they actually force the community to do something.

But they bring a lot of pressure to bear on them now that they have this capability to go to court and force them to do things. Usually, they can get them to comply by just telling them that they're going to force them to do it, and then they comply. But they didn't have that threat before that they could use.

So it was difficult in earlier times. They'd tell them, "Hey, you're not mowing the grass, you're not cutting down the brush, and things like that." Or, "You're not repairing the motors, they don't operate. You've got gates locked and there are no keys to the locks."

Things like that. They'd never be able to get them to take care of problems if the community was lax and didn't want to do it.

They'd go out and you'd see an inspection report come back one year, maybe two or three years in a row, with the same kind of complaints about their community not taking care of things. But, I think, because of this 221 agreement, that it's getting less and less of a problem.

Q: Now the Corps has a way of compelling compliance.

A: They can force them to do it now that they've signed the agreement.

Hoodplain Management

Q: We were generally talking about the floodplain management. Was it difficult to get the Corps to change and pay more attention to that?

A: Well, Goddard left and things got more on an even keel. They had a branch of the planning division assigned to do that, to promote that kind of activity. George **Phippen**-- I'm sure you remember George.

Q: Yes, I knew him.

A: He was in charge of it for several years. He was a go-getter; he got a lot of things for them to do. A good share of their work was with FEMA, just getting steady contracts and helping FEMA through the years trying to get the Corps' studies done, the way FEMA wanted them done.

But there was no longer this demand for the flood information reports as such. They were being done now as flood insurance studies. Then they had a program where the community could get help from the Corps. If they were having flooding problems, they could come to the Corps and get some advice. I understand now that they're going to have to pay for it from now on.

Last fall, when they agreed on the budget, one of the things was to start charging communities for that kind of assistance. But they used to have a program where if a community came to the Corps and said, "Hey, we're interested in trying to help ourselves

fix up our flood problem. What could we do?" The Corps could spend some time and money helping them out, giving them advice--and providing them with a flood information report that showed them what areas were subject to flooding and the probability.

Then they'd say, "Well, here are some things that you might want to do to alleviate some of this flooding. You might improve this channel. You might divert some of the water over in this direction. You might build a small retention project" or something like that.

But now they're going to have to pay for that, I guess, under the present process. Of course, that's kind of in keeping with the new planning policies anyway, under the new, I think, the '86 Act [Water Resources Development Act of 1986]. The Corps, now when they do a recon [reconnaissance] study, the community has to pay 50 percent of the cost of it. Well, they never use to have to do that. It kind of puts the community on the spot. Do you really want us to do this? If you do, you're going to have to pay money up front.

Q: Well, that's the whole purpose of the Act, to get them to share the costs.

A: Well, to make sure that they're not just pulling your leg or something.

Q: Yes, getting a freebie.

A: They want to be sure they're really interested in doing something. Because a lot of people or a lot of communities, after the Corps has gone through all the process of doing an in-depth study and gotten a project authorized, then they say, "Ah, well, we didn't really want one after all." That's a lot of waste of money.

Q: It's not wasted if it's not your money.

A: Well, yes, from their standpoint probably. But from the government's standpoint, it's not a very efficient way of doing business.

Q: You were talking about floodplain management and the whole issue of structural and non-structural flood control. How much involvement did the hydrologists have in that? Did they get into that issue at all?

A: Well, hydraulics got involved in a lot of the planning [of] channel improvements, for example, even though channel improvement is more the same concept as a non-structural. You can improve a channel and do it in a manner so that it still looks good. You're getting flood control by improving the capability of the channel to handle more flow, but you're doing it in an aesthetically pleasing manner, not the traditional concrete sides and bottoms, but with small channels in the bottom and with walkways along the side and different kinds of environmental plantings to make the whole thing look beautiful.

To do that, of course, they have to have a lot of hydraulic studies on the impacts of having or not having different kinds of improvements. Of course, they have to know what size floods they can handle with these type things, which is all part of the hydrology and hydraulics aspect. So as long as there is any analysis of what is going to happen to the water, why the hydrology and hydraulics people are involved in it. So it doesn't really make too much difference whether it's a structural or some sort of a non-structural approach to the problem.

One area which I've been getting into with my work now is flood proofing. It's part of the so called non-structural. It's really a minor structural element of the non-structural procedures where an individual is protected by raising or by sealing the house or by moving it.

There are a lot of different techniques you can use for flood proofing an individual house. People in the Corps--that's Jerry Peterson's group--have what they call a National Floodproofmg Committee. This committee is trying to promote ways and provide help to people so they'll motivate them to go out and do flood proofing.

That's an area where the Corps has been giving lip service for a long time. But when it comes right down to actually doing anything constructive, flood proofing for an individual project, they don't do it. There are a few places where it has been done, and it's been investigated in a lot of planning reports but the way they investigate it hardly ever seems to come out feasible. I think, personally, that that's one of the areas, untapped areas, of reducing flood damages in the future.

We're not going to be building very many more big projects because they're hard to justify and most all of the traditional structural flood protection works that are justifiable have been built. The ones that are marginal, they probably didn't get built. So what are you going to do about these people that are staying in the floodplain that are located in the floodplain and are going to stay there. They're not going to move on their own probably unless they get some sort of motivation to do it, and that's the whole idea of this flood

proofmg committee--to try to figure out how to motivate these people to do it themselves.

Well, I made some suggestions to them about what the Corps really needed to do if they were serious about flood proofing and that would be to modify the planning procedures so that they could really attack the problem. They have all the authority to do it, it's just that it's not politically or traditionally the thing the Corps does. They haven't really geared themselves up so they could go in and do a lot of assistance in flood proofing.

What they should do is have a community that has a lot of buildings in the floodplain, and [they] get this community to agree, or get all these people to agree, that they're interested in flood proofing. Then [they] go to the Corps in the traditional manner and say, "Hey, we've got a flood problem, we can't handle it. We're not in a position to handle it. We need a Federal project here. But the Federal project that we perceive being here is flood proofing, is mass flood proofing."

Then the Corps would come in and do a recon study along with them. But if you go through the traditional process, it's going to take you at least 10 years, maybe 15 years before anything happens. By that time the people that signed up for the thing are probably not even going to be there anymore. You need to have some sort of a process that will move quickly. They do have authority for that. They have their small flood control project authority, if it was funded adequately they could actually do a community under the small flood control project, and do it rather quickly. It wouldn't take so long.

The way I looked at it anyway, you don't have to analyze each one of these houses on the same basis, by giving them all the same degree of flood protection. As far as I can see, all you need to do is make sure that what each individual house does is economically justified by some means. I don't think you really need to do a full blown in-depth financial feasibility study. There are ways you can look at it very quickly and inexpensively to find out what you can do there and how much money you can afford to spend and still be justified.

If they [the Corps] had a more simplified method of looking at the economics of each one of these, they could go in and, with the help of the city, of course, which is contributing 50 percent of the cost on this study, they could look at each house and say, "We'll protect this one for two feet, this one for five feet, this one for three feet. We'll raise this one above the floodplain because all these, when analyzed individually, are economically sound. It's a good thing to do."

The Corps could actually have all this stuff built. The Corps could manage the thing because private individuals really don't know enough about it to know when they're getting a good job done. Besides that, if the Corps has many houses flood proofed all at

the same time, there is a big economic advantage to it. If you're doing things on a large-scale, the contractors will go in there and do a whole bunch of jobs a lot cheaper than they would do them individually. So there would be a lot of advantages of working that out.

But here I think the Corps is traditionally dragging their feet because it's not the kind of thing they've been doing. They say, "Well, we'd have a hard time proving the Federal interest" or "You're not coming up with the same kind of levels of protection" or "If you exceed the level of protection, the people are going to get damaged more than they would have otherwise and things like that."

Well, those are all legitimate concerns all right, but I still think that overall you could reduce the future flood damages tremendously and reduce the amount of money FEMA has to pay out for flood insurance and so forth. It just seems like an area where they have to be more aggressive than they have been.

Q: Is this part of the mind-set of the Corps that is so much into the big project that they can't see these little things as being part of it's mission?

A: Well, the sad part of it is, too, that in flood proofing, generally speaking, that people that have money are the ones that are going to be benefitted by it rather than the poor people. Because what happens is that if you've got a real expensive house located in the floodplain and you can show that damages to it are going to be pretty extensive, then you could afford to spend a lot more money fixing it up, protecting it.

Whereas, if you're living in a disadvantaged area and nobody has any money, the houses are not very expensive to begin with, so you can't afford to spend too much money on them. Then, if you do spend money on them, the homeowner can't afford to put up anything. But anyway, all the authorities are there, if they could get enough support for doing it? I think, traditionally, they've found out that they don't get enough, really enough, support for doing flood proofing to make it a thing to push.

But, from a practical standpoint, I just see it as one of the best ways to reduce flood damages. It's better than just keep paying insurance claims to these people year after year. Even if you cut out the payments to them to every five years, once every five years, instead of every other year or something, you've gained a lot.

Well, anyway, I was of the mind-set previously that you could go in and build a levee project for a lot of people [and that] was much better than fooling around with flood proofing. I still believe that. But there are so many places where you can't build a levee.

Even if you can build a levee for a good portion of the town, there are other parts of the floodplain that don't fit within that levee, that would not normally come within the protection of that levee, which might be a second part of the overall flood plan.

But, anyway, I was suggesting this to the flood proofing committee. They thought, "Well, that's not within their purview anyway, it's way beyond the authority they would have for doing anything like that. It would have to come all the way from the Chief's office, at the top level of the Chief's office, to investigate the possibility of a revision in policy in that area."

But, I think, as we've been talking, that the Corps is just very conservative. Unless they're pushed into it, they probably won't ever do anything much about it. Eventually, they might get pushed into it because there are a lot of states that are pushing flood proofing. They would like to see the government get more active in it. They try to do all they can but are meeting with quite a bit of resistance.

The Feds, like the Corps, are willing to do things like write documents about flood proofing. [Tell them] How you do it. Where to get help, if there is any help available, all the processes you need to go through, the reviews and the studies, the good and bad, and all that kind of stuff. They're willing to do that sort of thing and do research on what kind of flood proofing works and that sort of thing. But to actually go out and do it, they're not too aggressive in that area.

The Federal Engineer

Q: Well, like you say, they are particularly shy in some areas. I think you were probably there when they were pushing the idea of the Corps as the Federal Engineer. Then Heiberg decided that was being presumptuous, and they better not push that because other people like BuRec Soil Conservation Services, FEMA, and Department of Energy also had engineering talent. So they pulled back on that idea, but it was one of the relatively good ideas that they had.

A: Well, from my standpoint I would think that even, particularly in years gone by, they could have taken that philosophy without too many criticisms or pushed it pretty hard without too many people challenging them because they did have more staff. For example, the Bureau of Reclamation could have said, "Well, we're Federal Engineers, too." The Corps could. say, "Well, yes, you are Federal Engineers, too. But we are the Federal Engineer because we cover the whole country, outside of the country too. We're not confined by one part of the country like you are."

The SCS is confined to small rural watersheds. Obviously, they're not the Federal Engineer. FEMA, they look to us for their technical expertise and engineering. They couldn't be considered. Who else could be the Federal Engineer but us. I mean they could present a pretty good case for it. Now, I don't know whether they can do that so much anymore because they're not building the big projects, or at least not as many as they use to.

Hydropower --the Bureau has done a lot of that, but the Corps has done a lot more when you get around looking all over the country. That was a pretty active area for awhile there, when they were trying to add hydropower to all the existing projects, where private [owners] could come in and get a right to develop the power at various Federal sites.

Some of these companies went in and grabbed up the rights for all kinds of projects, whether there was any possibility of getting power there or not, just to be sure, just in case. Of course, they lost them after awhile because they were limited in how long they could take to develop the site. But some of them went out and grabbed up a whole lot of the Corps' projects, even the locks and dams, some of them didn't have much head at all.

Federal Energy Regulatory Commission (FERC)

Q: I know during the energy crisis there was a lot of talk of that and then in the early 80's there was a lot of talk about hydro.

A: We were fairly active in that program. In hydrology and hydraulics, we had hydropower as one of the things that we were involved in. We dealt with the Federal Hydropower Administration or FERC, Federal Energy Regulatory Commission--can't even remember the names of the agencies.

Q: Federal Energy Regulatory Commission.

A: Yes, the Regulatory Commission. Whenever there was a big private hydropower dam going in some place, they always got the Corps to do the hydrology and hydraulics connected with building that project and see what impacts it was going to have on floods downstream. In some cases, they had to add storage to their projects to take care of the increase in flow they were going to cause if they didn't have some storage. Our people in hydraulics and hydrology would do that assessment.

We had to maintain some expertise in hydropower for evaluating other people's projects besides evaluating the potential for our own projects.

Q: Were there any different techniques you used when you were doing that or was it just a different type of thing?

A: Well, that was primarily what we were involved in just looking at the hydrology and hydraulics of the projects. When we were doing our own, we were looking then at size of plants, based on the flow and the head. What size plant could you support and maintain firm power and secondary power and all that kind of stuff.

But when you looked at the others--oh, we got involved, too, of course, when they wanted to modify a Corps project to put in hydropower. They would come in with plans for what they were going to do with a Corps project to add the hydropower to it. Then we'd have to evaluate the practicality of doing what they were going to do.

We might have a big flood control release conduit. They might want to cut down the size of that by putting in a pipe that went over to a hydropower plant. To get that pipe in they had to cut down the size of our flood control outlet, then we'd have to try to decide whether that was an acceptable thing or not.

Obviously when we designed that flood control outlet, we wanted it that size for a reason. Then for them to just come along and say arbitrarily, "We are going to cut the size in half," doesn't fly. Either we made a mistake in the first place by making it too big or else something was wrong if they could go in there and just reduce the size of it without making some studies to be sure that there wasn't going to be a serious impact on the floodplain. So then we had to do those kinds of studies.

Then there were structural studies, too, of course, to be sure that when they made their modifications they weren't screwing up the stability of the plant that was there.

Q: Were a lot of the Corps' projects subsequently modified to have hydropower facilities--I don't remember many that they did.

A: There were a few. I don't think it was an outstanding number but there were several.

Q: I mean that seems to me to be one thing that has to be decided from the beginning or else you're going to have some problems.

A: Well, the thing that was important about it was if they could get the thing going before the Corps got their projects done. We had projects that were in the process of being designed and built,. If our project didn't have hydropower in it, if this non-Federal interest could get their facilities put together and designed fast enough so that it could be worked into our design, then it was much more acceptable, like you say.

But they were often slow in getting it there, and the Corps couldn't wait for them. It made a big difference in the cost of the project, too. If you could do it initially, you can design it so it doesn't cost as much if you have to retrofit, you have to go back in and redo something. So there were a few cases where they were having some trouble--that was when Gianelli got involved. He was involved in trying to decide when the time was that they had to have their certain things done before the Corps could accept them as a partner. It got to be pretty controversial on some of them.

William R. Gianelli

Q: You've mentioned Gianelli, I imagine Bob Dawson also would probably fit in your thinking. Prior to Gianelli, do you recall the Assistant Secretary for Civil Works having much impact on any of your work or any of the policies?

A: Well, they've always had some impact, of course. But, I think that Gianelli's was probably the strongest we ever had there as far as really telling the Corps what they were going to do and what they weren't going to do. He was dictating right and left how the Corps was going to function. He took a real personal interest in a lot of the details, which some of the ones previously didn't.

I remember working with the Assistant Secretary's office on some of our policy for urban development, urban studies, what constitutes Federal interest in an urban study.

To tell -you the truth, it was kind of a strange thing to do, but OMB [Office of Management and Budget] wanted a technical procedure for turning down cities on a flood control project. They said, "If certain conditions prevail, then you're going to be responsible for taking care of it. We'll consider that as the normal storm drainage for the community. If other situations prevail, then we'll call it a flood control interest and the Corps can get involved in it's normal flood control activities. But if you don't meet this criteria, why you're going to have to do it yourself." You may use Federal money from some other source but not from the Corps. You might use money from HUD or redevelopment or that sort of thing, but it wouldn't be a Corps project.

We come up with, well, let's see, who was the assistant secretary? I can't think of his name right off hand, but he came up through the Corps. He was one of the few that actually worked for the Corps his whole career. He worked over at the Rivers and Harbors Board.

They were looking for some technical assistance over there, and he said, "Well, I'll try it out and see." He applied for a job, and he got the job and shortly after he had been there for, well, he'd been there for some time. But the assistant secretary left, and he ended up acting for awhile and then he actually got the job for awhile. Then he went over to EPA [Environmental Protection Agency], I think, when he lost the job. But what the heck was his name?

Q: Well, he must have been one of the early guys because he certainly wasn't one of the more recent ones.

A: Gosh, I know--Jack--I just can't think of his name right now for some reason. But he was one of the fellows that reviewed projects over at the Rivers and Harbors Board for quite a long time. I remember when he was working for the Assistant Secretary of the Army, [they] told him there was a change in his job from a conventional civil service job to one of these political appointee jobs. Ford, Jack Ford.

Jack was saying, "Hey, I don't want to be a political appointee, I want to stay." The A.S. told him, "Hey Jack, everybody else can be fired anytime. Why are you so concerned about it? Just because you've been working for the Federal Government, if you have any confidence in your abilities you shouldn't be worried about whether you can be fired tomorrow or not." He said, "You're going to be on one of these Presidential appointment-type jobs."

Then when he became acting Assistant Secretary and, I think, I'm pretty sure he actually got the job for awhile. Then the Presidents changed or something, and he went over to EPA. But I worked with him on this urban drainage thing to come up with hydrologic criteria that would define when the Federal interest ended and where it began. The community interest that was worked out had certain size drainage areas or a certain probability flood where, when it was exceeded the Corps would come in and work.

Q: On a case like that, what's your guideline on making a decision on what the actual point will be? I mean, is it a political policy decision?

A: Actually, it was primarily a political thing. We tried different criteria, and Jack would go over to OMB and talk to them about it and say, "Well, if we use this criteria, here is about the way it will be." That we'll end up with saying anything bigger than, smaller than one square mile, why the government will never get involved with it. Or two square miles or something.

How many projects will that eliminate, how many projects would that keep the government out of, probably looked back over the ones that the Corps had worked on and stuff like that. They looked back and said, "Well, we would have eliminated all these projects here if we would have applied this criteria." OMB would say, "Well, that's good. Let's use that because we want to eliminate those kinds of projects."

They decided themselves (OMB) what was a reasonable, but they didn't want to come right out and say that. They didn't want to come out and say exact size of area or something like that because that would have been too arbitrary. They wanted to come up with some sort of a technical way of doing it. You're doing the same thing, it's just that you come up with some combination of probability of run-off and various things for different sizes. It makes it look more scientific, but hell, it's not really any more scientific than just doing it arbitrarily.

Q: So you were fitting some criteria to a political decision.

A: Right.

Q: What they felt was comfortable.

A: Made them feel better. It's the same way with dam safety. Gianelli was trying to find ways to turn down doing dam safety. He was looking at risk analysis as his savior so he would not need to spend any money on dam safety. He even promoted some conferences and stuff to get people to come up with ways to analyze projects so that he wouldn't have to--so they would still look good.

He didn't want to do, just like we were talking, make a political decision, "I'm not going to spend any money on that project." Just say, "Well, we're analyzing it and we'll keep analyzing it until we can come up with a way that says we don't need to fix it."

Q: So it's just expediency more than anything else. It's an easy way to get that political decision ratified. Then you get a yard stick by which you can gauge all the other ones you don't want to have authorized.

A: That's a way of getting people off your back. Just say, "I didn't just do this arbitrarily, like you might think I did. I did but it doesn't look that way. "

Q: All these good scientific principles.

A: It's kind of foolish to go through all that process, but I guess it's one way of getting people off your back.

Q: One of the things the Corps has never really gotten involved with on large scales is urban water supply.

A: Oh, no, they haven't done much of that. As I was mentioning before, I wrote my master's thesis on water supply. I was trying to figure out ways where the Federal Government could become more involved and pointed out all the different constraints on Federal participation in water supply. What the rules were for including it in reservoirs.

There was no way that the Corps really could get involved in a lot of these interbasin transfers and things like that because of water rights for one thing. One of the things they didn't really get involved with was conveyance facilities. They could come up with water supply in a reservoir, given that they had some party that was willing to say that they needed it for future water supply and were willing to make payments for it.

But some of that storage put in for future water supply probably never will be used for water supply because the people didn't have to start making payments on it for 10 years after they said they needed it. Then after the 10 years were up, if they didn't start making payments, then it no longer was reserved for water supply. If they started making their payments, then they could maintain their ownership of that storage. But a lot of them who asked for it for awhile probably would never actually take it. They just said, we're going to need it. Then, in case they did need it, they could hang on to it.

But as far as going out and doing single water supply reservoirs, I don't think the Corps has ever built--well, maybe I should take that back, there may be a case a two where they've built single-purpose water supply reservoirs, but they have to be darn few and far between.

Q: Single-purpose is very limited in the Corps now.

A: Well, even years ago. I think there was one in North Dakota they built primarily for water supply.

Q: For those small towns.

A: Yes, for those small towns. But there were some projects built many years ago for special purposes. I think they built some in those days when they had the--what do they call them, the CCC [Civilian Conservation Corps] or something.

Q: The Corps wouldn't have done something like that as much as the WPA [Works Progress, later Work Projects, Administration] or PWA [Public Works Administration].

A: Yes, Public Works Administration, or something like that where they were trying to find work for people.

Q: There was a lot of stuff like that at that time because, of course, the main criteria there was to get people to work.

A: Well, I think the Corps did some of those projects with that kind of authority. ..

Q: There were a lot of them.

A: We'll do the design work and all that and then these people will have a job. Well, actually, I think, Fort Peck was really a WPA project in a sense. It really worked as far as Fort Peck was concerned. They had 30,000 people there at one time working. So it was a pretty good at providing work.

Q: Bonneville Lock and Dam was in the same category, and you've got a little airport [National Airport] sitting down on the Potomac River that's in the same group.

A. Is that right?

Q: Oh yes.

A: It's pretty hard to look at some of those projects and understand how come they could build this thing in the first place when you compare it to some of the conventional ones.

Office, Chief of Engineers

Q: Let's go back to when you went to OCE from the field, what were the reasons for your leaving Garrison District or Omaha District or whatever it was?

A: Well, I was in Garrison District at the time. I was in the early days of my career, and I was looking for opportunities for an advancement, like you're always looking for. The reason I went to Washington, I had an offer from San Francisco District to go down there and work. I was seriously thinking about that, but I ended up turning that one down. When I saw this offer for Washington, I thought, I would give it a try. I sent in an application.

Shortly after I sent my application in, I got a call from Al Cochran, and he talked to me for quite a while about coming out there and working for him. But fortunately, I had had some good experience. Even though I hadn't worked very long for the Corps, I'd worked in several different areas in hydrology. I worked in Fort Peck for about a year.

I got involved in small flood control projects they were doing, like I mentioned on the Sun River. When I went to Garrison, I got reservoir regulation water control management experience in the hydrology section, plus some more hydrology work. Then I went to work in the planning reports section and spent a year or so in there. Then I went to work in the hydraulic design section where I was working on some of the hydropower work and the hydraulic design of surge tanks and things like that. So I got quite a bit of different experience in the area of hydrology and hydraulics in a short time. So, Al apparently thought that that was good for him in a review status where I was going to be working on reviewing other projects. Then I had worked for the Bureau of Reclamation, too, so I did have pretty good background as far as working on different things. It's a whole lot different then if you maybe had five years experience in one area. So when I went into OCE, I had been exposed to most all the types of studies that they did in there.

The people, of course, in the Garrison District said .I was crazy to move back out east where there are so many people. You wouldn't even have room to park your car or be able to find a place to live. But I never regretted it. I think it was a good move. I knew I couldn't stay in Garrison much longer anyway because it was getting to the point where

it was winding down and it was pretty apparent that people were going to have to leave there. I felt strongly that it would be much better if I left on my own choice than for them to tell me where I was going to go.

Q: That's always true, isn't it?

A: It usually turns out better that way.

Geostationary Orbiting Environmental Satellite (GOES)

Q: Let me ask you a question about the impact on new technology. We talked a little bit about computers and how much they affected what the hydrologist does. How about things like remote sensing and satellites that came in in the 60's and 70's?

A: Well, I think the hydrology and hydraulics type people were one of the early users of remote sensing. One of the areas that got some of the early work in that endeavor was New England Division and their water control management activities using satellite relay for transmitting ground data from sensors, such as temperature and water levels and rainfall and things like that were transmitted to the division water control center which made operating decisions. Well, they had fixed operating procedures but knowing what is happening, why then they can make the proper moves in terms of gate openings and that sort of thing.

But, I'm trying to remember right off hand. There were different satellites that were being used, GOES was the more versatile satellite. But, I was trying to think of the name of the earlier satellite they were using that was fixed in its orbit so that they had to get their data at certain times because the orbit of the satellite was fixed so that it didn't vary too much.

Q: It wouldn't move you mean, it was just permanent.

A: Whereas GOES had a different track type thing, and it was easier to pick up information from it. Anyway, there were two or three of those satellites so that with the GOES satellites you could get information almost any time. There was one in position so that you could use them almost all the time. But, information would go up to the satellite and be rebounded to a mechanism in the water--well, what they were doing at first in some places was going to the--I'm trying to remember this stuff, it's been awhile since--but it went to another agency, the space agency.

Q: NASA [National Aeronautics and Space Administration]?

A: NASA. They got the information they had to convert it so that it would come up on the computer in the proper format and all that. But, finally, the Corps got their own satellite receiving stations. We started getting some of our own wherever we had water control centers.

The Lower Mississippi Valley Division had their own receiving station, and they had that big antennae on top of the division office, a directional antennae so they could receive the information. They had the equipment to transfer the information into a usable format. But they were one of the first ones that had their own besides the New England Division.

But they were pretty expensive to begin with. Each one of those stations were very expensive. As time went on, they became less and less expensive. In some cases, there were a few agencies that were sharing a downlink, what they called the downlink, where they got all this information. It's great for all kinds of information. For example, in dam safety, you can put sensors on dams so that if there's any movement to the dam it could be relayed through a satellite back to a central point.

They can keep track of a gauge so if there's any movement at all, why they'll notice it. Not only do they have the information at the station, they can put some sort of a threshold device on it so that if there's a movement over a certain amount it'll ring bells or set off alarms or something so that somebody will immediately notice it. They're not probably paying any attention to it. They're not going to just sit there and look at it all the time. So that something like that you almost need an alert device.

Whereas things like rainfall and temperature like that, why they go in and take the recording off every so often, especially if they know about a storm in a particular vicinity, why they're right there getting all the information. From the rainfall, they have runoff models for watersheds, knowing the rainfall and putting that rainfall into their runoff models, then they can predict how much of a flood is going to come down particular rivers and what their water surface might be in an urban area, that sort of thing.

Q: So it makes it a lot easier to conduct flood fights?

A: Oh yes. It gives you a better chance to operate your projects more efficiently so that you'll know what's coming and what's on the ground. You know what rain is on the ground.

Q: So that all feeds into the reservoir management that you talked about before.

A: From all that data, then they can do a real good job. It's really the Weather Service's job to alert people as far as potential flooding and all that, but a lot of the information they get from the Corps of Engineers and from the Geological Survey.

But the Corps was one of the first agencies to have satellite-type data information. We got involved in it more, spent more money on it than anybody else too, probably at the very beginning. Then pretty soon, all the agencies started getting into it. Some of the agencies would go together and have a downlink or a common downlink where they'd all get data.

One of the big advantages to the Corps of Engineers and to the Weather Service was that in some of our offices we were co-located in the same building. We had a water control center and the Weather Service office in the same building, with one on one floor and another on another floor. So they had ready access to each other's information all the time.

The Weather Service could come down in the North Pacific Division [Portland, Oregon], in the customs building there. The Weather Service could come and find out what kind of reservoir regulation changes our people were making whenever they changed the releases from our reservoir or Weather Service would know about it right away. Well, I'm sure they still have all these things.

But they had a briefing room where everyday, sometimes during a flood emergency, more than once a day, the Weather Service and the Corps would all get together in the briefing room and they would be hooked up with the district offices so that the district offices could report information in. They had computer hookups so that they could show things on a screen computer on each of the district offices and in the division. They could share information by computers and so forth.

But it was a real great asset to be able to have all this information in one place and to be able to make decisions much better and get information. The Weather Service could get information to the general public much quicker and with a much more accurate forecast then they might have if had to do otherwise.

Modeling and Predictions

Q: That kind of data then was all used in your modeling and all your predictions, and things like that?

A: Right. The Weather Service--then there are a lot of different agencies that got involved in developing watershed models, runoff models. The GS developed a lot of them, and the Weather Service developed their own. Each agency kind of wanted them for special purposes. So they designed them to fit their own needs most.

But, actually, I guess the ones that the Weather Service developed were the ones that were used the most in times of forecasting floods for various major points, like in the major cities like Kansas City, New Orleans, St. Louis, and all those places where big floods took place.

There weren't too many places where they had that kind of a connection, but there were a few of them anyway. Like, I think, Fort Worth, the Weather Service and the Corps were in the same building, too. Missouri River Division, they weren't in the same building.

Q: The Omaha District might have been though?

A: I don't know.

Q: The District was in the Federal building downtown.

A: The Omaha District might have been, but the Division wasn't.

Q: Yes, they were way out west.

A: Anyway, wherever they could they tried to get as close to each other as they could so they could share information. They would make dual forecasts. They would make forecasts, and the Corps would make forecasts and they would compare them and see why they were different and try to come up with the best answer.

That was in terms of primarily the rainfall. But in the western part of the country, they had the snow runoff forecast made every year. The Soil Conservation Service got involved in that quite a bit as the Weather Service. There were a lot of the big river basins out there where they had to make those long-range forecasts, so they had reservoirs with dual-purposes, storage served for irrigation and for flood control. So you would draw it down in the fall and the late winter to make room for the flood.

You'd forecast how much runoff you're going to expect to get before the beginning of the irrigation season. If you were doing a good job you would draw down far enough so you could, when the irrigation season started, you'd be right at the top of the joint pool.

If you missed it, you wouldn't be full. You wouldn't have enough water for irrigation. If you didn't draw it down far enough, then you might not be able to control the flood. So it was kind of a balancing thing there. You tried to avoid missing it too far either way.

Q: Now that's where all these statistics that are gathered allow you to model that more closely. So your margin of error would be a heck of a lot less now than it was, say 30 years ago.

A: Yes, it seems like the problem is you run into a unique situation that you never had before. Like, I was trying to remember what, what year was it, '82 or something like that, that they had a big flood on the Colorado. But, anyway, they run into a situation then where they got a real heavy snow late in the spring where the temperatures got real hot right after this heavy snow. There was no way of forecasting this.

Q: Okay, on the Colorado River.

A: Well, anyway, what happened that year, they had gone through the spring without a terrible lot of runoff. They weren't expecting a whole lot of runoff, so they didn't have much storage left in the joint use storage. Along comes this big snowstorm late in the spring and then high temperatures right after the snowstorm when all this snow melted real quickly and ran off. They had a big flood.

There was no previous incidence like that, as severe as that, that they could use. Whenever you make up your rules for operating, you look back over the historical records, and you try to devise rules that will handle all those previous situations. But, usually, you run into ones like this unique situation as very difficult to handle because when it happens that late in the spring, you don't have much room to fool around with there. You're getting close to the irrigation season, and you can't keep the pool way down.

So when you get a late storm like that, you're in bad shape. You just don't have the storage available to take care of the flood. So you're bound to have some damage from those kind of floods. There's just no way you can do anything about it. They had a lot of controversy and argument and so forth about the people that had the reservoirs out

there, the Corps, the State of California, and the Bureau of Reclamation, about not operating the reservoirs properly. But there really wasn't much they could do about it. They probably did about as good as could have been done under the circumstances.

But after it, they had to review all of their operating procedures and get all the people together and argue about what could they do or could have done to make it less damaging than it was. I don't know that too much came about in terms of changes. Just one of those things you can't handle.

Q: Well, isn't part of the problem about historical information, historical data. But you've only been collecting for what, approximately a hundred years or so?

A: Well, if you've got a hundred years, you're really in good shape

Q: Yes, in most cases in most areas in this country, you probably don't have anywhere near that. So you're operating with a very small database. It's like your 100-year floods and 500-year floods.

A: Well, you see that would have been one of the problems in the statistical analysis of trying to determine what the 100-year flood is and so forth, because you don't have enough data. The sample that you have is not likely to represent what an infinite length of record would represent.

Of course, even if you had an infinite, you'd still have trouble predicting what is going to happen in the next hundred years. Because what you get for the next hundred years, you don't know which part of that infinite record you're going to get in the next hundred years. So even if you did have a perfect infinite record to go by, why you still wouldn't be able to tell people what is going to happen in the next hundred years.

Q: You may get your hundred year flood tomorrow. You may get nothing too.

A: You may get two to three years in a row or twice in the same year even, maybe. Then get nothing for a long time. Now, you get three or four temperatures over a hundred degrees in the one day after another and then not have a hundred degrees for several years.

Q: That's the wonderful thing about nature, isn't it? It's totally unpredictable.

A: You can become pretty good at guessing at what is going to happen, but sooner or later mother nature will throw you a curve ball or something so that you can't be sure what you're doing.

Q: But in the years that you spent in hydrology, it must have changed markedly.

A: Oh, it changed drastically. As far as forecasting, watershed runoff has really gotten into a much better science. Before they had some rules of thumb they went by, and that's about all they had in my early days in hydrology. At one time they built an electronic model for one of the rivers, I think it was the Kansas River.

In MRD they had an actual gadget, electric model. It was hooked up so that you'd input data into this thing and with this electric model, why you could forecast the runoff, but based on input as far as rainfall and river stations. But they were put in electrically--I'm not even sure just exactly how it worked now, but I know that I went out and watched it one time. They gave a demonstration on it. But it was probably the closest thing, at that time, they had to modeling the watershed. But it was a pretty crude device.

But that it was called an analog model I think. Pretty crude by today's comparison where you have fancy computers and you can do all kinds of things. The grand benefit of computers is you can do "what if," what's happened, how much rain has taken place up to the moment, and how much has fallen on the watershed.

So you can model that, you know pretty much what's going to happen in the next day or two now that you had that much rain. Is it going to continue to rain? If it does, what is that going to do to your forecast? If it quits raining, what's the forecast going to be? So you can start looking at what might the range of flood sizes be, depending on if it rains so much, why it's going to be three feet higher and that sort of thing.

But even though you have fairly sophisticated equipment for forecasting, it's difficult to get information to the people that are impacted by it so that they will really understand what you mean when you say that it's going to be. For example, a gauge at Washington, DC, if you put in the paper there's going to be a 100,000 cfs [flood] coming down the river, it will crest at that gauge tomorrow at noon, what does that mean to the guy living along the river? He has no idea what that means in terms of how many feet of water is going to be in his front room or that sort of thing.

So, really, the only measure they have is by comparison. If a person asks, "Well, how much higher is that than the flood that happened three years ago. Because I know how

high the water got in my house three years ago. If you can tell me if it's going to be higher or lower than that, then I have some reference." So if he says, "Well, if the forecast says the water is going to be three feet higher at this particular location than it was in 1986," for example, and that person knows how high it was, then why he can know what to expect. Otherwise, he just doesn't know what to look for.

So when you're trying to get information to the people that are being impacted, you need to have some sort of references for them to work with. Just doesn't do any good to tell them we're going to have a flood.

Q: I can see what you mean. They're not going to know at all what that means.

A: "Yes, well, so it's a flood, but am I going to be impacted?" That's the big question. It's hard to tell sometimes, too, because it depends on what their relationship is to the gauges where you're making the forecast. But, anyway, it helps a lot if they keep in mind particular floods in the past and how high they got, then they have a much better chance of knowing what can happen to them in the future.

Q: So you and the Weather Service--well, the Weather Service--will make the statements--it will be so many more feet and or something like that.

A: Well, and now they have better information, too, because of the flood insurance program. Most of the flood prone communities in the country are in the flood insurance program. So there is information on flooding in communities. People can, if they will make use of that information, they can get these, what they call FIRMs, flood insurance rate maps.

They show the floodplain, and they also have flood profiles and that sort of thing for the 10, 50-year and a 100-year floods. Even the 500-year floods so that if they're near a stream and they know the river mile and the stream that they're near, they can get a pretty good idea of how high the water is going to be in that particular location. So there's a lot better chance of fmding out what is going to happen to you now than there used to be even though the Corps or the Weather Service could tell somebody there was going to be a flood of 50,000 cfs or whatever.

They didn't have much of any way of answering a guy when he said how is it going to be in my house. So because they haven't done any water surface profiles in that area. In most areas, they hadn't performed water surface profiles. But now most communities have such things, which makes it a whole lot handier. Of course, this information is constantly being updated and improved.

The Flood Insurance Administration in getting their program, they did a lot of quickie studies where they didn't have as good of accuracy as they would have liked to have had. But they just didn't have the money or the time to do it in great detail, so they did all their preliminary studies and a lot of those are being, have been revised now and they're getting better information.

Not only that, but people who want to develop the floodplain, if they think that the water surface isn't right, they'll go in there and study it and come up with better answers and submit it to FEMA.

FEMA will review it and if they agree that it's a better answer than they have mapped, why they'll remap it. That's a lot of the work that we do at Dewberry & Davis -- remapping areas, redoing the computations and making sure that the new data is really better than the previous data. Because if it isn't better, why there is no sense in spending all that money to remap the floodplains. So if it's pretty close to what it was before, they don't remap it. But if there is a significant difference, why they will make a change.

The Environmental Protection Agency (EPA)

Q: Let me ask you about the impact of the environmental movement in the late 60's and the early 70's. Did that have any influence on what your hydrologists did or what you did in the Corps?

A: Well, of course, the Corps got involved in--and actually they were the ones that carried out the EPA rules and regulations. The people would come to the Corps to get a permit to do things and then whenever they would build anything in the floodplain or in a stream, wherever a stream was, if they put any fill in the wetlands, they had to get a permit from the Corps. The Corps was primarily carrying out the mandate of the EPA. EPA didn't have the mechanism to handle all these permits and stuff like that.

So EPA were trying to set up the guidance and get the Corps to enforce it, [trying to] keep people from building certain things and using up the wetlands. There have been a lot of rules and regulations and laws passed on just what you can do in terms of building in wetlands. If you do build, you have to compensate by providing other wetlands.

If for some reason you needed to build, or it was very important to build some sort of a development in the floodplain, those people that developed that, in order to get a permit to do it, they have to provide mitigation measures of some sort that are equal or better than what they've damaged by building in that area. Some times that is pretty hard to do.

There's no such thing as actually equal mitigation because the plant life or the animal and the fish life that you disrupted may not be duplicated. You may not be able to actually duplicate it, but you may be able to put some other type of fish or plant back in service in an area that didn't have it before to mitigate.

Q: But your work in hydrology would have been relatively unchanged by, I mean, you would have been doing the same things?

A: Well, hydrology, of course, got involved in where the wetlands wereand what constitutes wetlands, where are they and how much water is needed to create a wetland.

Q: Oh, so you were right in the middle of it?

A: Well, trying to decide where on the rivers is the normal ordinary high waterline, for example. Along the river, how do you go about determining where the ordinary high waterline is? Everything below the ordinary high waterline, it really belongs to nature. Once you establish the ordinary high waterline, anything below that is not really a wetland because that's the predominant level of the water.

There are different methods of how you determine that ordinary high water level. One of them I call a physical fact method, where you go out in a boat up and down the river and take photographs and then examine changes in vegetation along the bank. You can almost tell by observation where the vegetation changes, that is--lower vegetation has more water supply than the upper part. That is a pretty good way of determining what the ordinary high waterline is.

Then you can establish by hydraulic computations what flow it takes to get up to that profile at that particular water or line on the bank. Then you can analyze that flow and say, "Well, what is the frequency in that flow." You can also carry that same flow onto other streams where you may not have as good of vegetation line to tell you what is happening. So that there is a lot of hydrology and hydraulics involved in deciding what are wetlands and what are not wetlands.

Then there was, of course, a big hassle in the beginning between the Corps and the EPA because, well, it wasn't EPA at that time, the Water Pollution Control Administration, I think. But, anyway, the earlier studies on environmental impacts where the Corps wasn't as enthusiastic as the environmental people were about being hard-nosed. The Corps thought the environmental people were being too demanding.

They kind of dragged their feet in a lot of areas, not wanting to go as far as the environmentalists wanted to go. So there was a constant give and take between the Corps and the environmentalists about how far should you go to keep people out of the wetlands. How much they needed to provide to take care of the damage that they had caused. But it took a lot of negotiating and so forth to get all those things ironed out so that everybody agreed on what were correct requirements.

Q: Wetlands are still a major point of confrontation, I think, in the environmental area.

A: Oh, yes. Everything you do almost has some adverse impact on the wetland. You build a highway, a railroad, or a city or develop--especially if you do any kind of water resources development, why build dams and levees and that sort of thing, they're all in the wetland.

Q: That's why the Corps is such a favorite of the environmentalists.

A: The Corps has problems of their own, taking care of their own environmental problems. EPA would be after the Corps to do more than they had done and mitigate obviously in most cases, the Corps would say, "Well, this is enough." EPA would say, "Hey, haven't even begun to provide what you should." So they'd have to do some more negotiating and finally come up with something that would satisfy both of them.

Q: Weren't there various contending factors within the Corps itself onthese issues? I mean there was a lot of internal strife on these environmental questions.

A: It tends to go along with professional biases. When you get biologists and zoologists and people that deal with fish and wildlife and all that type of thing, why they're obviously going to be much more interested in preserving whatever we have. If you're a structural engineer and you want to build structures, you're not so interested whether some little obscure fish is going to be endangered or not. So, I think also, major structural works have been held up for years because of some minor endangered species.

Q: Or completely lost in some cases.

A: Some of the projects, they were never built. In some cases, why, of course, the people that were fighting for the preservation of that endangered species thought it was pretty

important. But other people probably had a hard time being convinced that it was that important. But should [we] give up something like a major hydropower dam because of some little fish or something like that that nobody had ever heard of before.

The sad part of it is, I think, whenever they're going to build something like that, immediately all the environmentalists assemble on the spot and start looking for everything they find there that might be put out of existence because of the project. Not only that, you not only have problems with fish and wildlife, but you have archeology interests who get in there and there's a burial ground for a famous Indian tribe that went out of existence 2,000 years ago or something, and they need to find those lost buried Indians.

There have been some pretty famous finds like that that held up construction of projects. While they had to go in and remove all remains and identify them all. They weren't sure they had them all, so they kept holding up production.

Q: If I'm not mistaken, the Corps has in it's possession, in various places, more various remains and pottery shards and everything else than about anybody in the world. Can't get rid of the stuff anymore either.

A: It's probably true. Whenever they build a project, that's one of the first things they do is go out and start digging for artifacts and seeing what they can find. They open it up for all these people that want to come in and do their digging. If they think there is something there, why they want to be sure and get it. Well, not only that, but when they go into construction and they start digging up the foundation for a major dam, they sometimes run into some artifacts or something, a real important find. They'll hold up construction while the archaeologists come in there and clean out the sight and get all the good things out of there.

Q: And then try to figure out what they all mean.

A: Where they come from and what each little thing means. But back in the early days when they were building big dams, there was a lot of controversy. You'd see big articles in ***LIFE*** magazine and other places about major projects and how much trouble they had getting them built and how many people objected to them.

Q: Well, that should all calm down, shouldn't it now, because there just aren't that many big places left to build big dams?

A: Well, they won't be building anymore big dams. Huge ones anyway. But most of the major sites have already been used up anyway. But that used to be one of the big bones of contention in designing the project sites. Here were the economists and some of the planners saying, "Well, we've got to optimize the benefits of this site. We've got to get the most benefits for the buck here" and all that kind of stuff. Analyzing the project.

Well, when they were doing this they might have one of the most rare dam sites in the country. It was impossible to find another one like it. Do you want to go in there and optimize that thing on present day conditions or do you want to build that thing to take full advantage of the available site there? Get all of the storage you can get while you're building it there or do you want to narrow your project down to just the size you can economically justify on the present conditions or something like that.

So sizing projects became quite controversial. People argue, "Why spend money today that you don't have to." But the problem is if you don't take full advantage of a site when you build it, the chances are you never will. You'll probably never go back and rebuild the thing. Although because of dam safety, there have been a number of projects that have had some major changes to them. Not only that but since they made it possible for a private interest to put in hydropower development in Federal projects, there have been quite a few add-ons to Corps and other Federal projects to provide hydropower facilities--take advantage of the dam site and add hydropower. They get a license.

Well, one company, I forgot what the name of it was, but they went out and they grabbed up a whole bunch of the Federal projects right away when it first became possible to do that. But then they had a limited amount of time before they had to start developing or they lost their permit. So after a certain amount of time why they didn't have the resources or the potential for using up all those sites. So they just used the ones that were most lucrative.

But there's been quite a few put in. That's a major problem, too, how do you put in a new hydropower facility with a dam that wasn't designed for it--retrofit an existing dam or hydropower. How do you use the flood control tunnels and if you do, are you reducing the flood control capability of that project or are you compromising the other project benefits by adding that hydropower on there. All those things have to be ironed out. The Corps has to improve the structural soundness and all that type of stuff before they'll allow [anything to be done].

Hydropower

Q: So there are a lot of very complex factors that would go into some of those things.

A: It was really difficult for a while there. Gianelli was in the Assistant Secretary's office at the time when that first got started. We were doing a lot of negotiating with people in hydropower and trying to decide which projects they'd be willing to put hydropower, future hydropower, too. Somebody would want to lay claim for future hydropower and get the Corps to put in the minimum facilities to begin with when they were building the projects so that eventually the hydropower could be added later on.

They were willing to pay a certain part of the cost of doing that because they had the permit to put in the hydropower and they could do it at a later time. But there's a lot of cost savings if they could do it right at the time the original structure was being built rather than wait until afterwards and have to put it in. So the question became then, "Well, how much money are you going to charge them for doing that and under what circumstances will you do it?" The hydropower wasn't authorized as a part of the Federal project.

So then when you go about building a project, somebody has to pay for that extra design effort and all the extra construction and all that sort of thing. Is the Federal government willing to do that and accept payment later or do they want their money today? All those kinds of questions had to be resolved.

So there was a lot of negotiating, and Gianelli got involved in a lot of that himself. His lieutenants would go out to our district offices and sit in negotiations themselves rather than entrust it all to the Corps. They wanted to have the hands in a lot of these things and didn't want to be caught unaware of what might be happening. So they wanted to be sure they knew exactly what was happening on every project. But the only way they could keep track of it was go and participate in the negotiation.

Q: Now that has to be a pretty good size gamble by a company to throw all that money up front if they wanted to do that. So what was the resolution of that. Was it on a case by case basis?

A: Well, I can't remember off hand exactly what the conclusions were, but in most cases they didn't have to put up all the money right up front. They would be expected to repay the cost in a certain time, and they'd have to start developing. The Federal Power Commission had their rules set up so that you would get a permit and that's good for so

long and then by the time that permit expires, you have to have started your design and [be] proceeding on to actually construct it.

By the end of that permit if you haven't done certain things, why then you can't keep your permit. It goes up for grabs for somebody else. Even the projects that have permits, they're only good for 50 years. There are a lot of these old Federal Power Commission permits that were issued 50 years ago. They're coming up nowadays for renewal. Just because you built the dam in the first place, doesn't mean you're going to get a renewal of your permit. The Federal Power Commission can give that project to somebody else if they want to. Not likely to, but they could.

Office of Research and Development (ORD)

Q: Let me change a little bit and ask you something about the establishment of the Office of Research and Development in the Corps. That's a relative newcomer. How did that affect the work that you were doing, especially the work you may have done with the Hydraulic Engineering Center?

A: Well, it became another layer, another management layer. Of course, the whole idea was to more efficiently manage the labs, the Corps labs, to have this office in the headquarters so that they could keep somebody who was spending full-time keeping track of all this stuff and trying to decide where the money should go and all that sort of thing.

But, by and large, there still was an awful lot of input --most of the input had to be done by the professionals who were most familiar with a particular type of research, like hydraulic design. Even though some of the people in the Office of Research and Development were a little bit familiar with what was going on, they didn't really know enough of the technical details to know whether certain types of research were worthwhile or not.

They had to depend on the monitors from each of the disciplines up in the Chief's office and from field offices. When they had these, they'd have R&D, oh what do they call them. Well, anyway, they'd have a--for various parts of the research effort--they'd have a get together each year and go over all the proposed research projects by the Hydraulics Lab, the Cold Regions Lab.

HEC would have an annual review and someone from the Office of Research and Development would be at that. HEC would, for example, lay out the program of all the kind of money they wanted and the projects they wanted to do. I would go to those

meetings, and we'd have people come in from the field offices, and we'd sit around and talk about each of these research projects. Some of them would be continuing projects, and you'd have to say, "Well, this project starts with a small amount of money this year and then next year we'll have a big amount of money. The following year we'll have a bigger amount of money and then it will start petering off."

You had to work up the long term, not just what was going to happen for the next year, and project out ahead. That was part of the things the Office of Research and Development did. They were programming this stuff into the future so that they would have some sense of dollar values. Just when they'd start a project, they wanted to be sure that they'd be able to carry that project through and not have to drop it half way through or something like that because of improper planning.

But anyway, a lot of time went into those programming conferences where they would get the people getting ready to make their presentations. Then they had one big programming conference in OCE where all the lab directors would come in and make their pitch before all the monitors in headquarters and the Office of Research and Development. They would all tell about all the good things they were going to do and the great results they were going to get from all these research projects.

If you didn't really know what they were going to do and what the prospects were for results, they could really give you a song and dance. You had to know your stuff or it would sound pretty good to you, eventhough it might not have been so great. So you had to know what was going on when you sat in those meetings and making your decisions. Hell, the whole group would work together and decide on which things were most important.

The problem was that even though you could find areas that seemed really important, who did you take money away from. Some new project would come in that everybody agreed that it was a great thing that we ought to be doing it, but who lost money to pay for that new project? Nobody wanted to lose money, they wanted to keep their own, their level up where it has been always. They were all trying to protect the amount of funds they had so it got to be quite a game there if you try to preserve your amount of money.

Q: So it would be like your people from hydrology would be fighting with the people from the structural side and the geotech people?

A: Everybody was in competition, yes. So, it was kind of hard--they served that role of kind of being the mediator or the...

Q: "Honest broker"--is that what they were for?

A: Yes, "honest broker," or something like that because, obviously, I'm in the hydrology and hydraulics area and even though I may be sympathetic to these other things, I'm still going to be wanting to spend all the money, all that money I can on hydrology and hydraulics. Here's Chuck Corns over in structures, he wants to spend all the money on concrete research. So somehow you've got to get people who don't have a particular bias, who just are trying to look out for the general overall good. That was really kind of the role they served.

Q: Was that one of the reasons that underpinned their creation?

A: I'm sure one of the ideas behind it was to have people who didn't have a built-in bias. Because the way it was--each element had their own research representative, and they didn't spend full-time on that. That was just a part-time job for them. Then they would all get together, and then they would have to kind of bicker over who was going to get how much money until the Office of Research and Development come along.

They then got into some more serious planning ahead and that sort of thing--look at future years. Then they got into deciding what were your high priorities. You would set up your most high priorities and then your second high priorities and third high priorities, and they got into some pretty fancy stuff where, depending on the feedback they got from OMB as to how much money they were going to get, you may get to have your first three levels of priority or maybe only your first two levels of priority.

So each research group would have to set up a bunch of priorities. This research project may be a number one priority, this other one may be number two or three or four. Sometimes you would go as long as five priority, just in case you got more money, so you'd have something waiting in the wings to put on research, into the research program.

Q: Would you discuss at length with the people from Davis what their proposals were going to be so you'd have at least some idea of what you wanted listed as priorities when you went in?

A: They would suggest to headquarters what their priorities were, which ones were their top priorities. Also they would, of course, ask us [for] any of our ideas on what they ought to be researching. They would ask the field offices to submit research proposals. Each

year any of the field offices, if they had an idea on a research project, would submit it to whatever element of research was responsible for it.

If it happened to be an H&H topic, why they'd send it to us. Then we would review and decide if that was a good topic. If it was a good topic, what kind of priority should it have? How would it fit in with the others? Based on all these submittals and sometimes there were quite a few of them, that would help us decide on what the research program would be.

Somebody from a field office was having problems with it, and they needed to get it solved. They didn't have any way of getting it solved. So let's have a research project and figure out how to do this here and who should do it. Then, the subject might come in to H&H and then we would decide, "Well, does this belong in HEC or does it belong in the Waterways Experiment Station?"

So we would take the topic and send it out to the lab that we thought knew the most about it and could do the best job of it and tell them to submit a proposal on it telling us what they were going to do and how much they were going to spend and how long it was going to take it and what kind of results they expected to get. Then -we would look at it and decide whether it was a viable topic to put in the research program.

That's how a lot of the research projects came about. But a lot of them were brought about by the people from research themselves, who had a good handle on what things really needed to have more work done on them or new work done.

Q: Now were you able to maintain a fairly level amount of funding for research and development in hydrology while you were there or were there great fluctuations?

A: No, there wasn't a lot of fluctuation. As a matter of fact, it's kind of like a moving train. When you get moving, why it's pretty hard to stop it. I mean you get the program built up, and you're halfway through projects or three quarters of the way through projects, and you can't very well stop those research projects after you've spent three quarters of the money on them. You've got to keep going on them.

So you've kind of got several projects going that are part way through, and you've got new ones coming on and others dropping off so it's a continuing process like that. But there are new ones coming on, old ones falling off, and others in the middle.

Usually, historically, what you've received in the past is a guide as to whether you should have a similar level in the future or not--to have new things that need researching. Hardly

anybody was willing to admit they didn't have anything new that they should be funded or they would run out of money. But almost everybody would come up with something to research. As long as they had a program, they would try to maintain it, of course. Sometimes they would lose money and then go down and battle them for more.

But they'd still lose money because they had, in engineering, a group of the researchers that would all get together. They would try to decide from an engineering standpoint what were the most important things. Then there would be engineering versus planning. They would trade off to see which things needed the most research and argue about why theirs was more important than the other guy's. Usually, the most articulate guy was the one who won out.

Q: We've talked about this before.

A: If you're a good speaker, why you have a lot better chance than the other guy.

Q: So by and large, though, the creation of the Research and Development Office was a positive step, you think?

A: Oh, I think so. It gave you, as a research monitor or program manager or whatever, you have somebody to go to. You go to them and say, "Hey, we've got something new, and we'd like to get it done." They would then start carrying the ball. They'd say, "Well, we'll see, we'll start talking with people and see what we can do about doing something." Otherwise, you had a tough time on new things.

Or if you didn't like something, the way something was being done, you had somebody to talk to. You had somebody who would listen to both sides and then would try to mediate or do whatever needed to be done. For example, there was research going on in hydrology and hydraulics down in WES that wasn't being funded by the Corps, yet the people in WES were doing it. It was being funded by another element of the Army or even some other agency was paying WES to do it. Our experts down there, who were supposed to be reporting to us, were doing this without even telling us about it. It used to really aggravate me when I'd hear about some hydrology research going on in WES. I hadn't even been questioned about what they needed to do or how we could help them or anything like that.

Maybe I mentioned it to you before about the one time that I got called by Bob Clark from the Weather Service who asked me about this research conference going on in WES about

new techniques in hydrology. I said, "What are you talking about?" He says, "Well, your Waterways Experiment Station invited us down to a big meeting on new technology in hydrology." "I never heard anything about it." He says, "Well, everybody else knows about it but you I guess."

Here part of the U.S. Army Corps of Engineers doing research hadn't even contacted their own experts to invite them to this exercise they were going through, that they had gotten a bunch of money to do some battlefield type hydrology. They were looking for new ways to do hydrology. But they hadn't even bothered to talk to us about even coming to their meeting. It really irked the dickens out of me. When they would approach a subject like that without using their own Corps expertise.

Well, you find other things like that happening within an organization that has a lot of technical competence. I used to find occasionally a relocation group who were in the process of relocating highways or something. They would do all their own hydrology, all their own hydraulics. They would do their own bridges. They wouldn't even go to the structures people to ask for help on bridges and things like that. They'd do all their own stuff. Sometimes the things they were using were antiquated as hell, you know, that people weren't even using anymore. But they wouldn't go down the hall and ask somebody that knew what to do. They thought they had to do it all by themselves for some reason.

Q: They didn't want anybody else in their business?

A: I don't know, protecting their little turf or something. But rather than getting a good solid answer, they were willing to stumble along and do the best they could. It's terrible, in my estimation, to see things like that happen.

Q: But that's bureaucracy at work, isn't it?

A: Oh yes, it sure is.

The Directorate of Civil Works

Q: At it's worst as a matter of fact. How much did the Directorate of Civil Works change during your years there? Personnel, of course, changed.

A: There were pretty significant changes, I think, then how different elements kind of seemed to be rising to the top. At the beginning, when I first went [there], engineering was kind of a top element in the Corps as far as having stature and all that sort of thing. The Chief of Engineering was probably the top, was considered the top engineer in Civil Works.

Then Planning started emerging, and it was building up. Then Programs and Policy were all part of Planning when I first went there. Then pretty soon Programs broke off and had it's own division. Policy broke off and had it's own division. Then the first thing you know, why Policy is more important than Planning. Programs is another big element.

Bory Steinberg

Bory Steinberg, when he was in charge of Programs, he got it built up to where he was the right hand man for Gianelli in the Assistant Secretary's office. They talked to him first before they even talked to the Chief. So he had a lot of influence on what went on. I'm not saying what he did was wrong. What he was doing, he was doing a really good job. He's an excellent manager and very technically oriented and all that. But somehow Policy is the most important thing rather than Engineering or Planning. Policy is all of a sudden the thing. Well, he moved from Programs to Policy.

Q: There was a lot of switching going on there for awhile, wasn't there? In the late 70's and early '80%General Heiberg as Director of Civil Works made a lot of switches?

A: There were quite a few switches, and then when they moved Engineering from Civil Works over to military construction [Engineering and Construction].

Lloyd Duscha

Q: When they created Engineering and Construction Directorate?

A: Engineering and Construction [Directorate], they took all of the engineering from Civil Works except Hydrology and Hydraulics. The reason they didn't take that was, I think, hopefully I had something to do with keeping them from breaking it all up. They wanted to split it all up and take hydraulic design over with. Lloyd Duscha wanted to take that over with him. Some people wanted to break up hydrology and give part of it to Operations and part of it to Planning, and anybody else that wanted some, why I guess

they could have had some. But, I think, I had persuaded General Wall that that wasn't the right thing to do.

I don't think General Heiberg [As Deputy Chief of Engineers,1982-83] was too concerned about it, as he was willing to split it up. I tried to convince him that it wouldn't be a good thing to do. But I wasn't all that convincing, I don't think, as far as he was concerned. But General Wall seemed to agree that it should stay intact, and so he kind of negotiated with Lloyd Duscha about, "Well, Gianelli wants to keep that in Civil Works, so he's going to have some control over it. I'm willing to let Duscha have a lot of the say so in what these people do. Especially in the structural part of hydraulics." He said, "As far as the other works are concerned, they can serve you and me. We'll work it out so that we both get the full service out of H&H." They seemed to work it out pretty good.

Q: Well, that's all gone back now hasn't it.

A: It's gone. .. In the process, the Engineering Division of Civil Works, just lost out terribly. When Lloyd Duscha was in charge of Engineering Division in Civil Works, he was the top engineer in the whole Corps of Engineers as far as Civil Works, well, even as far as military engineering was concerned. He had the highest grade, I think,-of any of the civilians. Then he moved over to the Engineering and Construction Division [Directorate] and took all that prestige with him, and he was the deputy over there.

What do they have when they come back? They didn't even have a Chief of Engineering. They've got an acting Chief. They still don't have a Chief of Engineering as far as I know. It's still been an acting job and a GS-15 is running the Engineering Division in Civil Works now. The size of the Engineering Division has collapsed so that there is hardly anybody in it anymore. So it really took a beating in changing from one director to another. From being a preeminent organization to kind of a back seat organization.

Q: Now it's all the other ones that we talked about--Policy, Programs, Planning, and Operations.

A: Operations, well, and of course part of this took place because Operations was getting the bulk of the money. Back in the early days when I went into the Chief's office, most of the money was for construction. Operation and Maintenance was a small part of the budget compared to the Engineering and Construction.

But then Operations money started becoming more and more prevalent, and finally it was a much bigger part of the budget than Engineering and Construction. The Operations and

the Maintenance became a big item. So that division became very prominent because they tell people where they can spend their money. If you want any money, you got to go to them to get it. When you're passing out the money, you get to do a lot of dictating about how it's going to be used.

Q: That's always been the case, hasn't it?

A: Oh yes, whoever has got the bucks has got the authority too.

Q: We're talking about a lot of your colleagues in Civil Works. What about the relative impact of the various Directors of Civil Works that you worked for. You've mentioned John Wall. Are there any others who left their marks on the directorate?

A: Well, there were quite a few of them, I don't think, that really changed anything much. They may have made a lot of noise here and there but actually I think probably General Morris [Major General John W. Morris, Director, April 1972-September 1975, later Chief of Engineers] was the one that had a lot of influence on what went on when he was there. Heiberg, too, had a lot to do in Civil Works. Let me think of some of the others.

Major General Charles I. (Chuck) McGinnis

Q: How about Chuck McGinnis [Major General Charles I. McGinnis, Director, July 1977-June 1979]?

A: Yeah, McGinnis did a lot, too. I really liked him. You could talk to him and he would listen to you. A lot of times he would do something about what you mentioned to him. A lot of times about dam safety. ..

Major General Jackson Graham

Q: Much more important than were the senior civilians who provide the continuity in the directorate?

A: Well, all of the Directors of Civil Works had their pluses and minuses. I guess some of them seemed to work with a lot of the people and others seemed to work with just a few.

Like General Graham [Major General Jackson Graham, Director, March 1963-July 1966], he was one of the most personable Directors of Civil Works we ever had. I think he knew everybody, and he talked with everybody. I've never seen a guy who could remember things like him. You'd give him a presentation on something, and he could make the presentation on the same subject after just having heard it once and do a good job on it. He did that all the time.

Of course, he'd go to Congress and make presentations based on what he had heard from his staff. He had a phenomenal memory for being able to do things like that. I guess, all that paid off when he was working on the Metro Washington Metropolitan Area Transit Authority subway system].

Everybody liked him. I don't know anybody that ever had a harsh word about him. Even a lot of the families of the people that worked in Civil Works knew him. My wife got to know him real well on the bowling team. He was one of the worst bowlers in the league, and yet he would come down there every time and bowl and have a good time with everybody.

Q: Well, he's one of those old pre-World War II Engineer officers. I mean not much pre, but certainly pre.

A: Then you'd hear about all the great things he had done when he was out in the field. He was really a person who looked after details. He wasn't too good to go out into the worst conditions and fmd out what was going on. He'd make sure things were going right. If there was any inkling of something being wrong or needing improvement, he'd go out and look at it on the site, no matter where he had to go to look at it. When he was working on the Metro, he use to spend his weekends running up and down with a motorcycle. Which is dedication at it's ultimate, I guess.

Major General Joseph K. Bratton

Q: That's true. Which one of the Directors most influenced the directorate during the years you were there? I imagine the years at the end of Heiberg's tour and the beginning of

Wall's when they made the big changes and reorganization under Joe Bratton was a major reshaping of the whole directorate.

A: Joe Bratton was one, I think, that was pushing for the engineering to be all one organization, not have an engineering, Civil Works, and engineering, military. He wanted it all in one.

Q: More like a division or a district structure?

A: Yes, he wasn't in favor of the two different engineering groups.

Q: Well, I know he told me one time that Gianelli got him very early on and said, "You guys are the Corps of Engineers, you don't even have a division of engineering as a major component of your headquarters. It's down in Civil Works." I guess from that point on he was looking for some way to...

A: But then when it come time to make the swap, Gianelli didn't want it all to go together.

Q: Well, he's a politician.

A: He was the one who didn't want to put it all together. He was arguing with Bratton that he should have it all together, and then when it came time to do it he was the one that was the fly in the ointment to keep it from being a full engineering division.

But one of the things that kind of happened, I think, was when they put it all together was that Civil Works kind of lost out on that, too, because the military had such a strong budget. There was so much going on in military work that there wasn't enough time hardly to look at Civil Works.

Q: During that period of about the early '82 or '83 when Civil Works had no new starts and no budgets?

A: There was a lot of work going on. So the Chief's administrators in the engineering side of the house were spending all their time on military things so that you couldn't hardly get time to talk to them. They were so busy that there wasn't anything they could do about it. They just had to spend more time on military than they did on Civil Works. That was

a time when dam safety was really an important area and well, it's still important, it's always important.

But we were trying to get something done about it. Lloyd was very interested in it, but he was being forced to spend so much time on military stuff that he couldn't spend the time on it that he had previously. So, I think, dam safety kind of lost out in that area. Gianelli wasn't too concerned about it so that when you had the engineering people who were so busy they didn't have much time to look at it, why it just kind of lost some of the emphasis it probably should have had.

Q: We've talked about the military a little bit and we've talked about Lloyd and a number of the other civilian people, in your career? about Frank Snyder a little bit. We talked about Al Cochran, we talked about Gail Hathaway. We talked about Francis Slichter. Who else among the civilians, the key civilian positions, were really the driving forces in Civil Works while you were there?

A: Well, obviously Wendell Johnson was one.

Joe Tofani

Q: Oh, I forgot to mention Wendell Johnson.

A: Wendell was always one of the best. There was Tofani, of course.

Q: Yes, Joe Tofani.

A: Everybody knew Joe and his connections and his ability to speak; all that sort of thing. He was one of the prime movers, and he was able to motivate generals in the direction he wanted them to go. He wasn't bashful about letting them know what the right thing for them to do was. Somehow he was able to get away with it without getting them ticked off at him. But, I guess, he had so much influence over in Congress, the general wouldn't say anything to him anyway.

That's how he got his promotion, you know. He got a major promotion when Congress passed a law and promoted him above his Division Chief, which really screws up an organization.

Q: **I'd** say so.

A: I think the Chief of Planning was a GS-16, and they promoted him to a 17 or something like that.

Q: Tell me about that.

A: I forgot it's crazy things like that that really foul up what a general can do with his organization. He can't very well have Tofani working for somebody who is a lesser grade, so he has to give him his own division.

Q: I know Joe. I've talked to Joe a number of times and Joe lamented to me frequently about the lack of aggressiveness and lack of push in the civil servant today. He said "We would have never stood back and waited. We would have manipulated the situation."

A: He was great--well, the thing is he had so much, I think, backing over in Congress, some of the senators and representatives and so forth, that if some general would have taken off on him he would have probably gotten himself in a lot of trouble. He probably never would be Chief of Engineers if he had gotten on Joe Tofani. He was one of the few civilians that ever had that kind of power, I think, in all of Civil Works. I don't remember anybody that was that influential ...

He just had the kind of a personality that he did get things done.

Q: And took a back seat to no one that I can tell.

A: He was quite a guy all right. Well, Wendell was a lot like that, too. He and Wendell were quite similar in being on top of the situation and always kind of being the lead, when they walked into the room they didn't wait for something to happen, they made things happen. They didn't wait for a general to ask them how to do something or what should come next. They'd start telling them what should come next.

And so anyway, there weren't too many people like that. I'm trying to think of somebody like that, perhaps Henry Weinkauff. I didn't really know him that well, but he was kind of an unusual type of guy. He was very concerned about his own professional image. If something went contrary, to make him look bad, he'd get all excited about it. He was always trying to present the top image no matter what the situation was. He seemed to be

more, to me, like he was more concerned about that than he was about getting the job done. Some of the others--you see people like that who seem to come first before the organization does.

Alex Shwaiko

Q: What about Alex Shwaiko?

A: Well, I knew Alex pretty good. I knew him about as well as any of those people. Well, what can I say about Alex. We'd go out in the field, we'd go to conferences out there. Onetime he came to the meeting, he wasn't prepared at all until he got into this meeting. He didn't have the foggiest idea of what we were going to be talking about.

He hadn't been briefed or anything. So he took an absence from the meeting. He was gone for a couple of hours while we were meeting and then he came back later, and he was right on top of everything. He kind of took over the meeting then.

But sometimes he just wasn't prepared, and I don't know whether he just hadn't had time to get his briefing or he had forgotten what the whole thing was all about. But once he got all of his notes together and remembered what the hell was going on, why then he was right on top of it. He would get things done. But it use to be puzzling to me how he could do that. But he had a lot of meetings, I'm sure, that he had to go to, and Alex did not like to delegate authority to others. He was quite the guy though.

Q: Well, now he was a person that moved from Programs to Policy or something, wasn't it?

A: Well, he was in charge of Planning.

Q: Planning to Policy.

A: If some of those jobs changed, I think they were just trying to make way for somebody else, they moved some people around so that they can get a person they want in there who has some special capability. So they move another guy. I think that's what happened to Alex.

Joe Auberg

Q: Well, he liked the Capitol Hill scene didn't he?

A: Oh yes. Well, I think that his primary activity was being over on the Hill and briefing Congressmen and senators all the time. He spent most of his time doing that I think. That's probably why he wasn't ready for some of those meetings because he was so busy off lobbying for one thing or another and trying to get projects. Now, he was one of others who did things like Joe Auberg--1 know Joe Auberg worked for Alex. Joe would tell Congressmen how to get around the laws and stuff like that. Some Congressman would be wanting to do something and Joe would say, "Well, if you do this, you can get it through."

Q: You can make a lot of money on the Hill doing that kind of thing, can't you?

A: Well, he was just giving away his advice. Finally, I guess, the Assistant Secretary's office got so mad at him that they took him over in their office and then locked him in a room where he couldn't talk to anybody. But he was always conjuring up some project or how they could get it through. This was at a time when the President didn't want to spend any money. He was giving Congressmen ideas on how to get their projects.

Q: I can think they would lock him away.

A: There was Gianelli trying to figure out ways to stop spending. But anyway, Alex was kind of like that, too, in a way. He was there to help them in anyway he could. A lot of them really didn't know how to go about promoting their own projects, and he would help them.

Q: That really is one of the things that Gianelli and Dawson especially didn't like, wasn't it?

A: They didn't like that at all. They would have preferred not to have Civil Works people going over and talking to Congressmen. As a matter of fact, I think they picked people that they would let talk to Congressmen. They would call up the Director of Civil Works and say, 'Well, obviously Bory Steinberg can talk to them and Alex can talk to them. But I don't want these other guys talking to them." They had their own people that they knew would be pretty cautious about what they said and so forth.

Augie Smet

Q: What about Augie Smet?

A: Oh, Augie and I went to Graduate School at Catholic University together. Went to school there at night for about five years to get a master's degree, and Augie and I had several classes together. But Augie was, he was a really hard working programmer. Well, let's see, I'm trying to remember, Bory worked for him. Augie was in charge of programming.

He was always a hard worker. He spent a lot of time with OMB, of course, as most of his work was with the OMB staffer in setting up the funding for years and arguing with those staffers as to how much monev thev could get for the various things and trying to educate them on how to do things and why they needed the money and all that sort of thing.

Things can get really confused over in OMB. I remember one time there was a budget for water quality. Water quality was new and, well, especially the Executive Branch of the government didn't want to spend a lot of money on water quality at the time. But we had a big budget for water control management, big budget, you know, because there was all this satellite stuff and gauges all over the country and a lot of people working in it.

So we had a staffer over in OMB who was looking over our budget, and he didn't know the difference between water quality and water control. He thought water control was part of water quality. Well, they're somewhat related. What you do in water control has something to do with water quality. But water quality is a sub-part of water control, not the other way around.

But, anyway, he thought it was all water quality. He cut the budget by 80 percent or something like that. Just really wiped it out. After they sent in the budget, why he "X'd" that out and put down about 20 percent of what they had asked for. We had a hell of a time with him trying to explain to him what the difference was and why all these things were necessary.

We took him out to the field offices and showed him around to two or three of the water control centers and explained to him exactly what each person did and how water quality was just a small part of the overall--so you could cut out all of the water quality money and you wouldn't have much of an impact on the water control budget. But when you start cutting out the water control budget, you don't have anybody left that knows how to operate the reservoirs.

How are you going to operate the reservoirs if you don't have people who know what the hell they're doing? How are you going to get your data if you don't have money? Well, we finally got him educated, and he put the money back in.

But those were some trying times when you get people that were so new to the water resources area that they couldn't understand simple things like that until they had been thoroughly educated. Some of those were trying experiences that Augie had to really work hard getting us and them together and getting all this stuff straightened out so that you didn't lose a lot of money when you really needed it for some essentials. It wasn't some add on, you know, that they thought we were just going overboard on water problems.

Q: **Yes,** you get a lot of that.

A: Anyway, Augie had a tough job, I think. When the Administration is always trying to keep costs down and he was trying to keep the programs going and convincing the staffers. Then once he gets them convinced to get their bosses convinced and so forth.

Q: Especially, I guess, when they're politically motivated like some of the Reagan Administration people must have been.

A: Well, they're always trying to make a name for themselves--some of those upper echelon people at OMB. They're close to the President, and they might get something big, appointed to one of the agencies, agency heads, or something.

Q: Become a more important person.

A: Well, when Carter was in, it was a weird time. We had all these young people heading up major offices that really didn't know doodle about anything. The first job for some of them. They came in as an Assistant Secretary of an agency and 30 years old and never even had a job before. They were suppose to be managing Federal programs.

Committees and Jake Douma

Q: After the end of the last session, we got into a discussion of committees. I thought that was a very interesting discussion where you explained why a committee would be used and

how a person like Jake Douma used the committee. Would you like to go back and discuss that again and how technical experts like yourself saw those committees assisting your work?

A: Well, it kind of took the place of the normal engineering manuals, which take a long time to evolve and finally get written. Not only does it take a lot of money to get all the expertise you need to put together a manual, it just seems like it takes forever to complete the dam things. One of the ways, especially the hydraulics people, got around that slow, burdensome job of getting a manual written was to set up these technical committees, like channel stabilization and some others, too.

They got together the people that they knew in the field offices that had good expertise in the area, and they'd get them assigned to the committees. Then, before they met, they would send out a notice to district offices about when they were going to meet and ask for subjects and information on problems in that particular area. Then people would be invited if they had a problem, even though they weren't a member of the committee. They could come and make a presentation on one of their problems.

The committee would then review what the problem was and make comments on it. They may do some extended study on it and actually come up with some documented solutions to the problem so that the committee notes then formed a basis for technical documents for use by the different districts even though they weren't an official engineering manual. Most of the experts, anybody doing channel stabilization, would collect the notes from those committee meetings and use those as a source of assistance and help in doing their channel stabilization work. So it was a way to get the most out of your limited number of experts.

They would invite people from other organizations sometimes to participate. They would hire consultants to help them out, to work on doing a special job for them. They would review what the consultants had done and add their bits to it until they finally got a good document on whatever subject they were working on. So it was and still is a good tool.

Q: Now you said that was a convenient way, too, of offsetting manpower shortages or technical skill shortages at OCE.

A: Well, that's true because there were very few people in a lot of the disciplines, as I indicated before. The hydraulics people do not have much more staff now than they did then. One person for navigation, which is a big subject; another person for coastal work; and another one for the hydraulic design. Each one of those subjects is pretty tremendous by itself.

Well, hydrology is quite similar. There would be one person assigned to sediment. Another one assigned to water quality. Another one to water control management. Another one to review basic hydrology reports. So there's not too many experts in OCE. They had a lot of areas to cover. Of course, another thing, when the district offices want to have a conference and they want to get assistance on some particular project, they always want to have the best people they can get from headquarters. They don't want to take somebody who doesn't have a lot of years experience.

They always try for the person with the most experience, somebody they really know well. You can't always get them, of course. There is not enough time and energy available for one person to cover every meeting that goes on. But, one of the things that we talked a little bit about, I think, was what are the impressions of the other elements regarding hydrology and hydraulics in terms of doing Corps business. Is it a help or a hindrance and all that sort of thing.

Well, it's a basic discipline for almost everything you do in water resources. People have to know enough about it, or they can't get by at all. Planning people have to have a lot of hydrology and hydraulics. They get upset when they get delayed in their reports because the division officer and OCE reviews the material and finds that it needs some additional studies.

Revisions slow down the report process and obviously they get upset about it because that schedule is what they want to meet. They view these delays with disdain, and the people that are causing them, the same way. So there was a lot of resentment about comments. Most of the time, they're really legitimate comments, but once in a while, they will get some kind of a comment that is just a designer's choice and not really a proven difference. But the views of the guy in headquarters usually prevail of course. Something like that happens, that gets the district upset because they have to go back and redo something that they didn't want to take the time and delay their reports for.

Hydraulics and Hydrology

Q: Now, would your section or your branch or division there, would your experts see every one of the reports that was being prepared in the Corps and all the districts and divisions?

A: Most of them. Most of the planning reports-- occasionally they wouldn't, we would miss some of them. But generally, you see, most planning reports have a lot of hydrology and hydraulics background. The material may not always be in the report, it may be in an appendix which is not published or it may be in a separate document--but they really need

a. review of almost all those. I remember one time General Wall, when he was Director of Civil Works, we had a meeting with all the district engineers. They were all complaining about comments from OCE. General Wall got up and said, "Well, we didn't review at OCE, that was the responsibility of the division office. " But he was talking about the general planning process. I was sitting in the audience and I was looking at him and I was waving my arm. He said, "Oh, that is except for hydrology and hydraulics. " He says, "We do review hydrology and hydraulics at OCE. "

Some of them would have preferred that we didn't do that. There are a lot of things that are very important. If you miss something and it gets through Congress, Congress passes it, and the project's authorized, then you find out that the project won't work the way the planning report said it was going to work. You can get in a lot of trouble with Congressmen and everybody else.

So you have to be pretty careful that you don't plan something and present it to Congress that isn't fully operable, and not only that but meets all the economic and other tests. Things like flood frequency have a big impact on the economic viability of a project. If you make a big mistake in the frequency analysis, it will cause a big mistake in the benefit/cost ratio. So other elements do have problems.

If a design element in engineering decides they want to go ahead and make a complete design on something and then find out that it's a wrong size, won't pass enough flow, or is at the wrong elevation in the structure because it may not pass the right water temperature or water quality, they find that out too late. Then they've got to redo it and redesign everything. That can make a big difference, too. So they all have concerns when the hydrology and hydraulics people say, "Hey, you made a mistake. You need to redo something and it will cost time and takes extra effort. "

So by and large there's a lot complaints about your review. I mean, you don't usually get bouquets, usually they're throwing bricks at you. But it's a worthwhile type of work if you occasionally find something that really was botched up, then you can correct it. That gives you a good feeling of satisfaction and makes you realize that you're doing some good.

But one of the things that I talked about before, too, was the fact that I wanted the Hydrology and Hydraulics element to stay as a unit, not to split it up and give parts to the other major elements. I feel, and most people feel, that it's important that the Hydrology and Hydraulics people are not influenced by any more political pressure than necessary. I've seen cases myself in field offices where Hydrology and Hydraulics was under the Chief of Engineering. He would look at the results of some of those studies and decide on his own that the results weren't good.

They'd tell the Chief of Hydrology to go and change his study. He may not be an expert in hydrology at all, but because he thought the answer was too big, he'd say that we can't afford that kind of an answer. I know that happened at least in a couple of cases where we have a design flood, called the standard project flood in the Corps of Engineers.

In one of the offices I worked in the Chief of Hydrology came up with the standard project flood based on his best estimates of all the components that go into it. He sent it forward to the Chief of Engineering, and the Chief of Engineering looked at it and he says, "What's the biggest flood you ever had there?" Well, it was only about a quarter of the size of the standard project flood. He says, "Oh, that's way too big." You go back and cut that thing down considerable, he says, "That's way too big. It's going to cost us too much money to design for that."

So the hydrology group was busy redoing it trying to cut the parameters here and there and everywhere to make the final result less. While they were doing that, along comes the biggest storm they've ever had, that was almost as big as the standard project flood that they had already presented. So the Chief of Engineering immediately says, "Cancel my order." But you see that can happen. If they are not kind of an independent group, they get those political pressures.

For example, if a project has a close B:C ratio, it won't quite make 1: 1 ratio, why they may get pressure to move their pencil in the direction that gets more benefits. They have to have the choice of doing the best job they can without having somebody trying to alter their answer for them.

One of the reasons that the Corps paid money to the Weather Service, National Weather Service, to do the extreme rainfall analysis for probable maximum floods was because we didn't want the people in the Corps to be pressured by district engineers or chiefs of engineering divisions or planning divisions or whoever when coming up with their best estimate of the probable maximum precipitation.

They were able to work independently without regard to economics of projects--to work independently strictly on the technical, meteorological aspects of the estimates. It's good to have that freedom, not to have somebody pushing you for a high answer or a low answer. So, I guess, that's one of the things that the Chief's office really ought to continue to give those people at least enough independence so that they don't have that pressure on them all the time.

Q: Well, that sounds like it's one of those areas that needs to be protected and that's why I gather you really fought ...

A: I did all I could to try to keep it as a separate unit ... and I think most people realize that that's an important element. But, some would still like to bust it up and put the parts that they use the most in their own office. It would spoil the whole operation.

Q: Now how many hydrologists would a normal district have in their office?

A: Well, it depends a whole lot on how big of a work load they had. Well, back when I was working in the Garrison District, for example, they had one GS-12 as a Chief of Hydrology, Hydrology Section. They had one, two, three--three GS-11's. Then they had three or four GS-9's, plus some GS-7's, all working on different aspects of hydrology. That wasn't really a big district.

Then they had in the branch, the Hydrology and Hydraulics Branch, another section in hydraulic design which was not quite as big but it had maybe five people in it. Another smaller section on sedimentation, there were three in that section.

The fourth section in the branch was what today are the planning people. It was a report section. But they were the planners at that time. That had several people, too. They were the ones that wrote the planning documents that went to Congress. They were a part of the Hydrology and Hydraulics Branch at that time. As they eventually evolved, they became a division comparable with the Engineering Division.

Q: So they really are pretty well staffed then?

A: Oh yes.

Q: In most cases?

A: It will depend on the work load, too, how many people they have. If they have a large staff and they don't get enough work, sometimes they can get work from another district. One of the things we did in Garrison District was work on some projects for the New England Division right after one of the major hurricanes in New England. There was a lot of investigative work going on on potential dams. We did the design work on two or three of them.

That helps keep the work load distributed around the Corps. One district has too much, why they can use other districts. Of course, they use consulting firms a lot, too. They use consulting firms more now than going to another district I think. But at that time they were encouraged to go to another district rather than go to engineering firms outside the government.

Q: Is that primarily because of the lack of manpower across the agency?

A: Well, that was a lot of it. But a lot of it was that they didn't have too much confidence, especially in the hydrology and hydraulics area, in some of the private engineering firms. But, nowadays, they are a lot more competent than they used to be in that particular area. Most of them hadn't done enough work in that area to really say they were experts at it.

I don't know--with the small number of dams that the Corps is designing nowadays, it won't be too long before they won't have any experts on how to design dams. Then they'll have to go to private industry because a lot of the private firms get the experience in foreign countries designing projects for another country or for the World Bank.

Q: That still wouldn't affect the hydrologists as much would it? Because they still have a lot of the other things they have to do-flood control, etc.

A: Well it wasn't so apt to impact those as some of the people like the structural designers especially. It's a tough thing when you're running out of big projects to design. You have these people with all this expertise, what do you do with them? You have to retrain them or do something. They can't just sit there twiddling their thumbs so you want to keep them because you might get another job to design. But that can only go on for so long and then pretty soon you lose your experts. They go off somewhere else and get a job.

So it's been tough through the years to maintain the kind of capability you'd like to have in each district office. Some of the divisions have tried to use one of their districts--they'll say, "We'll make one of our districts the prominent experts in that area, and we'll move the best people we have from the other districts to that particular district. And then they will help all the other districts so that you don't have to try to maintain a full staff in each district."

Q: Has that worked relatively well?

A: Well, as far as I know, it's been okay. I think SWD [Southwestern Division] are the ones that did it more than anybody. But some districts don't maintain much of an H&H staff, they just go to HEC or the Waterways Experiment Station to get their help--the in-house Corps help and then use consultants. So it's a real mixed bag, I guess, the way the various districts handle their cluota of people, how they use them and how they feel they have the most demand for them.

Two Types of Personnel in the Corps: Lew Blakey and Al Cochran

Q: We were talking the other day, too, about the people you had worked with. One of the people that I hadn't talked about, but I guess I should, is Lew Blakey, who was in a number of different positions.

A: Well, I guess one of those things you could say from my experience with the top people in the Corps--there are kind of two types. One is a person who is kind of concerned about his own prominence. He's trying to build up his own stature by writing professional papers, by being active in professional societies, and getting his name on his papers as much as he can, trying to do things he can to draw attention to his own capabilities. He spends a lot of time doing that and not as much time working for the agency.

Then there's the other type who is real--they're all real good--but I mean this other type who doesn't really give a hoot about being prominent and well recognized and all that sort of thing. He just does a hell of a good job where he is, Al Cochran was one of the latter type. He knocked himself out trying to do the very best he could for the Corps of Engineers. Working nights and spending a lot of extra hours and getting the best help he could. He didn't worry about his own stature too much. He just worried about getting the job done.

But, I don't know why he was that way, other than maybe he felt that being Chief of Hydrology and Hydraulics, he wasn't really looking for a different job, he was satisfied where he was. But other people that try to be recognized, not only do they like the idea of being recognized as a top authority but it helps them get higher paid positions.

But each of these type of people benefit the Corps, you know. It benefits the Corps that one of their people is recognized throughout the world as being the top expert in some particular discipline. How they happen to get that recognition may have taken some of their time from their normal work to get that recognition, but still it benefits the Corps to a great deal. So it's kind of hard to judge one person, which one does the most good for the Corps in the long run. But they both do a lot for the Corps.

Frank Snyder was kind of the opposite from Al. He was concerned with coming up with new innovations and things like that. He liked to work on research type things and develop new ways to do things. He'd write professional papers and everybody knew who he was, and he did a lot of international work. He retired relatively young to go into private work.

But he was really a lot more recognized throughout the world than Al was because of his international activities and his working on research type things that other people finally used. Everybody knows Frank Snyder's unit hydrograph method, and he got recognition from Ohio State for being an outstanding civil engineer. He's had a lot of recognition.

Gail Hathaway was the same way. He liked to be recognized for what he did. I was **leading** up to what you asked me about Lew Blakey, how am I going to fit Lew into this category? Well, Lew, I think, is from my standpoint--he was guy who got things done that the generals wanted done. If they thought it was important that all of these reports get in on time, why he'd get them in on time. Now they may have suffered because they got in on time because they did not have the same quality, but he got them in.

If the general said he wanted something in, then by God, he got them in one way or another. It did not make any difference how hard he had to work or who he had to push, he'd get them done. But he and I had some differences a lot of times about what was more important, getting the report in on time or having a high quality report. You can take different viewpoints on that. I felt pretty strongly you ought to get the highest quality reports you could get to begin with, and then you didn't have to worry about changes.

He didn't view it that way in a lot of cases in some of his jobs. He must have been good, you know, because he got a lot of good jobs. He got moved around a lot, and he got the kind of jobs he wanted, but he seemed to be good at them. I don't know of any of the generals that didn't like him. Whoever he worked for, they all seemed to like him real well.

But I had my differences with him about his planning reports because it would bother the hell out of me if a survey report was due in on a particular date and the guy in hydraulics and hydrology that was supposed to review it was off on vacation at that time. So it didn't get reviewed, it went in anyway, whether it was reviewed or not. But it got there on time. That was what was important to get the job done.

Personally in some cases like that I'd rather see it delayed. But then again I wasn't the guy that was managing reports either. My credits weren't for getting the report out on time, my credits were for making sure the thing was right. So it all depended on where

you're sitting, what the priorities were. But, obviously, when people have two different goals, they're going to lock horns once in awhile. And we did occasionally.

Q: Yes, well, I locked horns with Lew, too. I didn't come anywhere near winning_

A: Oh, he was a tough person to battle with. He went after me a couple of times. But a lot of times, I think, generals kind of used him, too. They thought he was willing to take on all kinds of adversity to get something done. Save them a lot of headaches. So they let him go ahead and do it, even though they may not agree wholeheartedly with everything he was doing, why not let him fight the battle for them. He'd do it. So, it all depends on your outlook and where you're sitting whether he was doing a real good job or not as good of a job. But Lew and I got along fine as long as we weren't working on something together. If we were just talking about the weather and so forth, why we could do that pretty peacefully.

Survey *Reports*

Q: Well, there is certainly a very great price to pay when you begin to sacrifice quality for time. Especially, I imagine in your area where you really need to be careful in what you're doing?

A: One of the biggest problems I think we had was headquarters never did come to a final or a straightforward position on what they wanted with survey reports. They were always vacillating back and forth. One day it would be we want just the rough estimate of what the answer should be and then we'll take care of it when we get into the general design phase. We'll do all the detailed work and fix things up when we get into the general design phase. That's all right if you do it, but they didn't do it.

Then when they got to the general design phase, "Oh, well, that's suppose to have been all settled in the survey report. We shouldn't have to rehash this stuff." I'd say, "Well, you guys didn't do anything in the survey report. How can you say that it's all done if you didn't do it in the survey report, you've got to do it some place." Now I never did have a particular concern about whether it got done up front in the survey report or whether it got done later in the General Design Memorandum as long as it got done.

But I got hit both ways. The planning people said, "We don't want to spend a lot of money on hydrology and hydraulics on the survey report. We'll do it in a General Design Memo." I'd say, "Well, okay." Then I get to the General Design Memo, and the guy in charge of the General Design Memo, he'd say, "Oh, they did that in the survey report.

We don't have any money for doing that." I'd say, "Well, you can't play both games. You've got to do it one way or the other. " So a lot of times we had trouble getting the studies done that we needed done because of that game, it went back and forth all the time.

Q: Well, wasn't one of the things that Gianelli, Dawson, and Page all came down on was that these survey reports were not done well enough to really make a decision on some of these projects?

A: Well, a lot of them are like that, yes. There were a lot of them that remained in Gianelli's office for a long time. I remember Lew reporting to our staff meetings how many survey reports he had gotten in that particular period and how many were stacked up over at the Secretary's office, none of them going forward. Just sitting over there.

It always used to seem to me--here I'm concerned about the quality of those reports and he's concerned about getting them in to the Secretary's offices who are just going to stack them up in the comer some place--why not use that time to improve on the quality of those reports. So we never did see eye to eye on that because he didn't get any credit for a report that was out there being massaged and improved. He got credit when it came into the office.

But what you're saying is quite right. They were concerned about it. They weren't getting all the information they needed to make decisions, but I think a lot of it was just that the Administration didn't want the reports. They didn't want them sent forward because that meant that Congress might start appropriating some money for projects that the Administration didn't want to spend.

ASA/CW Review of Work

Q: Well, how did you find the Assistant Secretary's office as far as the quality of their review of your kind of work?

A: Well, they really didn't have anybody over there that could review our work. I don't think I ever remember anybody over there that knew much about hydrology and hydraulics except Jack Ford. Their work was more in the planning area, in a general overall picture. They had the economists over there, too. Of course, Ed Dickey? his primary expertise is economics. But most of the others that were over there had backgrounds in planning or

economics or environmental work or something like that. They weren't usually in the particular technical discipline. They were more in the broad range planning type things.

Q: So they weren't really the engineers that could make a real estimate of the engineering involved?

A: The sad part of it was--Gianelli, he thought he knew all the stuff but he didn't. He certainly didn't know hydrology and hydraulics or if he did, he hid it pretty clearly, because we'd go over there and talk to him about dam safety and you could tell he wasn't the least bit interested in what you're saying to him. He'd sit there and listen to you, I mean he'd sit there--you knew he wasn't absorbing any of it or really thinking it was worth his while. He just did it because it was kind of forced on him.

Once in awhile you had some people that got involved in pseudo-technical matters, like when Jack Ford was over there, he got involved with OMB on trying to set up some criteria, technical criteria for making decisions on where the Federal interest stopped and the community interest started when it come to stormwater management.

I got involved with him on some of that because OMB didn't just want to come right out and say flat out, "We're not going to do anything in areas smaller than ten square miles or something like that." They wanted some sort of a technical reason for turning down projects or turning down work. So we had to develop kind of a hydrologic model about certain size floods or--anyway we came up with a manual that described a Federal interest, where you stopped it. It was based on a lo-year flood in a certain size area.

So, anyway, they got a technical procedure that wasn't strictly arbitrary. But the sad part of it was the technical procedure was so loose, it was based on average conditions, and you don't hardly ever have average conditions anywhere, [it's] either greater or less. But it did serve their purpose so that OMB could say, "Okay, well, that won't meet our criteria or requirements so we won't do anything in that area."

Dam Design Criteria

Q: They basically wanted a formula that they could put this project up against and say it doesn't meet it?

A: Well, the same way with the Secretary's office when it come to dam safety. They wanted some sort of a formula that they could turn down repairs on a dam. They wouldn't turn down repairs on a dam without all kinds of studies. Not only that but they wanted to keep the studies going and going and going to delay decisions but it still ended up where they had to make a decision.

The Secretary's office never wanted to be in a position of saying that they turned down repairs on, or rehabilitation of a dam for dam safety. If they turned it down and the thing failed, look where they would be. So they never wanted to be in that position. So they always had you restudying it or trying to come up with some special criteria that would get them off the hook. You know saying that here is a new criteria for evaluating dam safety and it meets that, the dam meets the criteria so we don't have to do anything to it. You know that would frustrate me a little bit when they would do that sort of thing.

When it came to which dams they would put some money in fixing them, they would pick the one that cost the least amount of money, not the one that needed it the most. All that used to aggravate me. They would pick a dam which I thought should have been way on the bottom of the priority because it wasn't going to cost as much to fix that one. But then they looked better because they were fixing some of them.

Q: Well, how did that settle with the Congressional people who were interested in this kind of thing because it's a very high visibility safety issue to the general public, especially after all those problems they had in the late 70's?

A: One of the things that is pretty obvious are the structural features of a dam. If something becomes obvious structurally that it's got a crack in the concrete that is a serious crack or it's got a seepage problem, really a severe seepage problem and something might happen, the whole dam might go out or something like that, you didn't have too much trouble getting money to fix that. That type of a fix, and they call that rehabilitation, they didn't call that dam safety because they could identify an exact physical problem and so they got money for that without too much problem.

But when they got into things like the probable maximum flood? the present day estimate of the probable maximum flood, if it was bigger than the one that they used to design it with originally or maybe they didn't even use the probable maximum flood originally, would that dam withstand the present day probable maximum flood, and in a lot of cases they wouldn't.

So you'd see if that dam needs some modification so it will pass the present day standard of a probable maximum flood. Trying to convey the real need for doing that was a lot harder than showing somebody that it was physically crumbling. You'd say, "Well, we've got a bigger flood than we had before." If that big flood comes it will be overtopped and might drown everybody downstream. The response would be "But that's rare, though--it's not going to happen, the chances of that hitting this particular dam are rare."

We'd say, "Yes, you can do that kind of a manipulation if you want and decide how infrequently that big flood would hit this dam if you knew how to do it, which you don't know how to do." You can do some studies and say, "Well, this is so rare we don't need to worry about it." The answer to that is, "Yes, but there are many dams in the United States."

They're all over the country. Everywhere where there is a stream almost, there's a dam. Maybe it won't hit the one you were interested in, but it's going to hit some of them somewhere. If you don't design them all for a high level of protection, sooner or later, some of them are going to start failing because those big floods happen here, there, and everywhere. But it's hard to convince people. That's always been a big battle.

You'd get the economist-type people who would say, "Well, we need to do a benefit/cost type analysis on everything we do." That's always been the vogue in the Federal Government. How much are we going to get back for what we spend? They force people to do that type of an economic approach on almost everything they do, even though they can't do it with any degree of accuracy. They require some sort of an estimate of that sort of thing.

I used to get upset when people would start saying, "Well, they're going to do probability estimates of floods out to the probable maximum flood which is the biggest one..." Nobody knows what the probability of that is because, as we talked earlier, you only have at most about a hundred years of records at any one location. Maybe a few hundred years at rare places, but that won't tell you what is going to happen in terms of thousands of years, and that's where you're dealing. I argued with them again and I said, "Suppose it's a l0,000-year flood, as opposed to a 5 0 , 0 0 0 -flood. Which difference does it make to you? I mean how can you tell."

If somebody tells you that that dam was designed for a l0,000-year flood and someone else says, "Well, this other one is a better dam because this was designed for a 50,000-year flood, does that mean anything to you." It doesn't mean anything to me, so I don't see how it can mean anything to you. But if they tell me it's designed for a bigger flood, which can happen, then I have some feeling for the need to do that. But when they start throwing these rare numbers at me, they don't tell you anything really.

Q: They become a source of confusion more than anything else then?

A: Well, sure, and then they start throwing in economic analysis with those rare risks. When you start thinking about that, the dam fails and 10,000 people are drowned, what is their life worth? How do you go about deciding what an average life is worth? Besides that, who are those people going to be? The ones living right downstream from the dam, it's not something like an airplane where you don't know the victim, a victim in an airplane could be anybody. Anybody that flies airplanes. But the people--right downstream from a dam--don't want the dam design based on a benefit/cost ratio. They want it safe.

Safety Problems

Q: Maximum safety?

A: So anyway, you run into those kinds of problems and justifiably so because there are only so many dollars to go around and you can't spend all the dollars on dam safety, you've got to spend dollars on welfare--all kinds of other things. So there's always going to be this debate on the best way to spend your money.

Q: When you were doing these dam safety studies and investigations, what impressions did you have, based on your studies, of the people who designed these dams? I mean the Corps has a reputation for being extremely conservative in it's design philosophies. You said some of these dams didn't even take into account the probable maximum flood.

A: Well, either they didn't take [it] into account or they made a reduced version of it. The Bureau of Reclamation had that problem. Of course, for many years they had a different procedure for justifying their projects and paybacks on their projects. Irrigation and hydropower, those are project benefits that have to be repaid by the beneficiaries.

The people that are getting the power have to pay for it. The people who are getting the irrigation water -have to pay for that. So they have to have somebody to pay for them. Therefore, whoever pays has to pay for this extra safety. It goes along with the project--having to pay for that extra safety.

To get projects that were acceptable to the beneficiaries, they had to try to be as low cost as they could. Otherwise, they wouldn't get anybody to pay for their projects. So they kind of went overboard in cutting down on the size of their design floods, arguing that,

being in the mountainous areas, they didn't need to worry about floods as big as the ones that we were looking at over in the plains. They said, "Well, storms won't move as far in the mountains. You can't transpose a major storm from one location to the other in the mountain areas like you can out in the open area where you don't have big mountains."

There was a lot of controversy between the Weather Service and the Bureau of Reclamation about transposing storms. If you didn't transpose a storm very far and there weren't any other big storms in your area, you could say that the potential was small there. So there was a lot of controversy. That was a big reason why the Corps was having a lot larger probable maximum floods than the Bureau of Reclamation.

The SCS, they used the National Weather Service to get their probable maximum precip [precipitation], same as the Corps did, but they didn't put freeboard on their dams. They would design the dam to take care of the highest level attained by that probable maximum flood without any freeboard. The Corps always added freeboard on their dams.

I guess the SCS could argue that since their dams were usually small dams, they didn't need to worry about wave overtopping, run-up and waves overtopping, as much as the Corps did on it's big dams. So they had less conservative design than the Corps. Then you get into the states and the kind of requirements they put on--a lot of states didn't have any requirements. They would let you build almost any kind of dam you wanted to, and the states wouldn't care.

Since the big dam safety study several years ago that the Corps did and many dam failures, they've gotten a lot of the states to put in requirements. A lot of the states have adopted the standards we used to investigate whether a dam was safe or not. They use the same kinds of standards that we put together to evaluate the non-Federal dams. Those standards were really not supposed to be design standards. They were supposed to be standards to look at existing projects under the concept that it's awfully hard to change an existing project. It's better to spend more money in the original design.

So we set up some criteria that weren't quite as strong as what we would have wanted them to use if they were building a new project. But just to find out whether they were reasonably safe or not. But states picked that up and said, "Well, that's design criteria." Our view of it was safety evaluation criteria, not design criteria. They say they're one and the same. But, anyway, that was interesting. At least it increased the design level most states were using.

Then they have a big problem if there's no development downstream from the dam, a lot of these states won't have a major requirement on how you build the dam. Maybe they' 11 use a 100-year flood or even less in designing the dam because there's nobody living

downstream from it. But the problem is you build a dam and before long everybody starts moving into the floodplain down below it because they figure there is not going to be any floods anymore down there, even though it may not be designed for flood control.

People move into the floodplain and then a flood comes along that's bigger than that 100-year flood and those small dams fail and people get drowned. The whole concept has changed because people have moved in downstream. That was one of the considerations we had in deciding on what kind of a flood that the dam had to be able to pass without failure. It had to do with how many people were living downstream. Would failure cause a lot of people to lose their lives or none or a few? So we had different requirements for different conditions downstream.

Q: That sounds like the airports. You build an airport and everybody moves around it, and then they say there's a safety problem because you've got all these businesses and houses around the airport.

A: They moved in there because the airport was there.

Q: Was there, right. Then the airport is the source of the safety problem.

A: Right. Well, dams in some way are like that. A lot of dams are built, and they say, "We're going to control floods and save lives by building these big dams for flood control." What happens is they have more people drowned in the reservoirs than they ever had drowned from floods downstream from there. People get in their boats and take along a keg of beer with them or a bunch of whiskey, and they get out there and get intoxicated and run into each other and fall out of their boats, and even go over the spillways like some guy did at Fort Peck.

A couple of guys were out fishing in a boat and the boat motor quit on them, and they drifted toward the spillway--real slow at first because they were quite a way from it. One guy jumped out of the boat and swam to shore and the other stayed with the boat, he kept trying to get the motor started. Pretty soon it got to the point where he couldn't swim, the water was going too fast, and he went right on over the spillway and down the chute and, of course, got killed. So those incidences are happening all the time all over the country.

Q: Well, there has been a big program in the water safety program at those reservoirs. It doesn't do any good with some people, does it?

A: Oh, absolutely not. All you have to do is go where there are boats, and you can see that a lot of people have no regard for safety at all. They charge around with those high speed motors without even knowing what they're doing. A lot of them hardly even know how to start it let alone act safely.

Q: Of course, the Corps can't control that because they don't have the authority to license those people. On the reservoir, all they can do is charge them a fee to use it,

A: Well, they have rangers that if people are misbehaving, [acting] in an unsafe manner, they can ask them to leave; but still--I don't know that they have power to arrest them and take them to jail or anything like that. But they can ask them to leave. Their rangers or whatever they call them. Water resources types.

Stormwater Management: Chicago

Q: Let me change a little bit. You talked before about stormwater management. When I was out in Arizona talking to Major General Richard M. Wells, he talked about when he was a Chicago District Engineer and they had the TARP project, the Tunnels and Reservoir Project, that they wanted under the city. He had to come to some kind of agreement with the EPA on the proportion of stormwater to wastewater. Were you involved at all in those discussions?

A: Well, not too much. The district engineer did most of the negotiations and that sort of thing. That was a special, really a special, project because it wasn't designed necessarily for flood control. It was primarily a water quality type project to begin with. But they had to treat all that water, once they mixed the wastewater and the storm runoff, and put them in the same storage area down there. They couldn't take it out of the storage area without treating it.

So the bigger mix you have of wastewater with the stormwater, why the more treatment it takes. I'm sure that the EPA and the Corps had quite a time coming to grips with what they were going to do in terms of treatment. The idea was that they'd like to cut down on the amount they had to treat because it cost so dang much money. If they could separate the stormwater from the wastewater, why then they have not nearly as much volume connected with the wastewater. That's one of the things, most of the old cities have sewers that are combined sewers. They take both stormwater and wastewater.

So how do you get this "no pollutant" goal that the EPA was trying to get when you've got stormwater and wastewater mixed together. If you're going to meet that goal, you've got to separate all those sewers. How much would it cost to do that, to tear up all the streets in the major cities in the country and separate those storm sewers from the sanitary sewers so you could treat everything ? Otherwise, you have to treat all the stormwater along with all the wastewater. So that's the type of a problem you have--what can you do in terms of cost. You can't treat everything, it's just too expensive to treat everything.

Q: That TARP project was mainly to take the stormwater, wasn't it?

A: Yes, and wastewater.

Q: I lived in Chicago. I know what happens when you get storms of a huge dimension in the city. We use to have a basement full of it all the time.

A. Well, it's so flat. It takes a long time to get rid of it, and it doesn't runoff quickly, it stacks up all over the place. It was really probably the only way they had of helping the flood situation there because even if you build facilities, channel improvements and so forth, the slope is so flat that they can't carry a lot of water. The only way you can do it is if you put it underground like that, in storage underground, then it's not going to overflow on somebody's property.

Then you keep your pumps operating all the time, and you only have a storm occasionally so that you get it back out into the rivers when it's dry or not raining. It's just so costly to do it that way--putting in those reservoirs, underground reservoirs, huge diversion facilities, and all that costs a lot of money.

They had a few of these open pits, too, they were using in their plan where they had taken out rock from the rock quarries. I guess you've seen them when you drive around Chicago, there on the Interstate. You see them every once in a while. They would also enter into their plan.

Well, we reviewed the plans that came in. But it was so complex that you really didn't have enough time to go into all the details of the projects. In our office, we didn't have the staff that could look into it in great detail.

St. Louis

Q: Did any other cities have a similar kind of problem? I mean of that dimension, that magnitude?

A: Well, I don't know--every city has a problem with stormwater I know. But I know that the Corps got involved in a lot of interior drainage facilities. In St. Louis, they have a major levee around St. Louis, the Corps does, and it's a huge one to take care of a really big flood. So they have to have facilities to get rid of the water that runs into the interior -- I mean from the rain that accumulates over the city.

If the Mississippi River and the Missouri River stay up for long periods of time, it can't drain interior water out so they have facilities to get rid of it. Even if the river is down, they still have to have conveyance to get it through the line of protection.

So the Corps got involved in building a lot of interior drainage facilities. Increasing the size of the conduits underneath the levee with gates on them and pumping plants and all this kind of stuff. When I first came into Washington back in '58, it wasn't too long after that a lot of these reports would come in from St. Louis on their interior drainage and there was a lot of money involved in big pumps. A lot of complicated designs, and how they were going to handle the water. Because the water was coming down, ponding at the levee where all the big industry was. Any water that stayed in there was going to cause a lot of damage. So they had to get rid of it.

Q: Now that was on both the east and the west sides of the river--both in east St. Louis and in St. Louis itself.

A: That was one of the bigger projects that I got involved in as far as actual interior design of projects. Even though you had a big levee there, it was already there, and they still had a lot of work to take care of the interior flooding.

New *Orleans*

Q: Did New Orleans have problems something similar to that?

A: Oh, New Orleans still has that problem. They never have solved their problem. But one thing--the flood insurance program has put them in a bad [situation]--because a lot of this interior drainage, the interior storm collection and all that stuff, is really the responsibility

of the local people. If they don't do it, why it doesn't get done, and they suffer the consequences.

The Corps will do the main levee for them and some of the major collection facilities or the major items right at the line of the levee. But getting all that water down to the levee and to this major facility is another problem. In New Orleans, the normal water level on the Mississippi River is above the land within the levee. So you've got to pump everything. You can't drain it by gravity. There's no place to drain it, too. So it costs a lot of money to get rid of all that water.

The parishes down there have a tough time convincing FEMA that they're doing something to reduce future damages. Part of being in the flood insurance program is that the community is taking strides to reduce future damages in their area and preventing development in the floodplain.

Well, if the whole area is floodplain, how do you prevent future development in it because people are going to develop and there's no place else to develop. They're actually developing in the floodplain and so FEMA says, "Hey, this is against our policy to let anybody develop in the floodplain." The parish says, "Well, that's all we have. We're all floodplain."

Anyway, they've had some court cases about what they need to do. They have some agreements. We've got some in the office now that we're reviewing where the community or the parish has started working on future facilities to take care of local and interior drainage. But that is probably the worst city in the country as far as maintaining a flood free area.

Q: A city that shouldn't be?

A: Well, a lot of people think so. They talk about the 100-year flood as the basis for the floodplain, you're talking about half the state of Mississippi or Louisiana, you know. If you spread the 100-year flood, most of the state is going to be under water.

Q: Yes, and an awful lot of money is spent down there to keep that river from going where it wants to go.

A: Oh yes. Well, you see there's so many complex problems there. They build levees to protect against hurricanes and the main river flow. Then the doggone levees, the ground

is so soft that the levee settles after you build it up. So it starts going down, down, down and then pretty soon the level of protection isn't what it's supposed to be.

So you have to build it up again. So it's a system or a series of stages of construction. You build it up so high, and then it settles down, and then you build it up again. You keep gaining a little bit on it each time, but it's a very expensive process.

The same way with the capacity of the main river--it fills with sediment. Then they have to go and dredge the whole thing out to maintain navigation and to help the flood carrying capacity of the river. The Corps has diverted a lot of water over into the Atchafalaya Basin by the Old River Control Structure. You've probably heard about all the problems they had with that thing, and it almost failed.

Q: That was '73 that it almost went and had a lot of trouble back in what, 1983?

A: Oh they've had trouble several times there. But '73 was the worst.

They have these facilities, like the Morganza floodway and the Bonnet Carré floodway. Whenever they put those into operation, everybody screams and hollers. They don't go into operation very often, but when they do, then a lot of people get wet.

So then they even have things like the New Madrid floodway, where it's completely developed agricultural land and that land has flowage easements on it by the Corps to use it as a floodway when the Mississippi got too high, so they could relieve the pressure on the levees--let's see where is it? Is it Cairo that is right there?

Q: It's up there north, yes, it's in Missouri.

A: That's right. Cairo, the main levee on Cairo. If they get enough water, if they don't open that New Madrid floodway, the stage is going to get high enough so it will overtop the levee. So with all these people living in the floodway, how are you going to open that thing?

They have to crevasse it with bulldozers and explosives in order to make the thing work because the people wouldn't let them put big pipes or gates. So the only way they can [do it] then [is] to amass a flotilla of equipment to do the job. All those people are going to know about it before you get there. They're going to be there with their machine guns and bayonets to stop you.

Q: Yes, I've heard that--I forget who was talking to me about that. They feared for their lives if they ever went up there to try to open that thing up.

A: Oh, they have tried, they were getting prepared to do it a couple of times; and they never have done it, but they were really thinking they were going to have to. That was always one of the big questions with the Secretary's office--What is your plan for making that thing work and how is it going to work? Will it really work? If it isn't going to work, why don't we do something else? What can we do? Are there any other solutions? They looked at trying to come up with other solutions, but there just really isn't anything that would take the place of the floodway because it will carry so much water.

But that was one of the problems that the Water Control Management Committee had. That was another committee that we had. The Water Control Management Committee was composed of all the chiefs of the water control branches in the division offices. We met regularly to solve, try to solve, some of these problems like operating the New Madrid floodway, problems with TVA and the operation of Kentucky-Barkley projects--one TVA and one Corps--and connected with a channel between them. We had problems with TVA on that.

Then all the concerns about the Atchafalaya floodway and sediment that was accumulating down there. What's going to happen when so much sediment gets down there that it is filled up? Or when is the Atchafalaya going to take, capture the Mississippi. When is the levee system going to fail? The people at Louisiana State University tell you it's going to happen anytime now. Professors down there ran articles about it all the time. Whose going to win the battle, the Corps or Mother Nature?

Q: Well, there will be some time that Mother Nature is going to win.

A: Well, probably will eventually but...

Q: They'd save a lot of money in New Orleans, won't have to worry about all that levees and pumps and all that stuff.

A: Well, it'll be right back there. They want the navigation in New Orleans. There's nothing down there at the mouth of the Atchafalaya. Morgan City is about all you got down there, there is little navigation. So they don't want all that water down there. Even if it did break through in a spectacular flood, they would go right back to recapturing it.

Q: It would keep them busy for a long time, wouldn't it?

A: Keep them busy, but it may just wipe out one structure. Then the water all goes through that one structure. Miles and miles of the main levee may still be intact so all you have to do is replace that one expensive structure. You don't have to redo the whole reach because once it gets through, it's going to keep coming through that same location. Unfortunately, the structures that are there cost a hell of a lot of money.

Q: From one of my discussions, General Heiberg was on it in that '73 flood. He told me when he was up there, he thought that thing was going.

A: You stand on the control structure? with all that water going under it, and boy you worry. I was on it, too.

Q: He said it was just bouncing up and down.

A: And you see the big boulders that they dumped in there and they just went right on through--trying to fill up the holes. The flood dug a real scour hole underneath that structure. They wondered what the hell was holding it there.

Q: Well, one end was completely undercut.

A: Underneath the structure was an awful big hole. So after the flood went down enough, they started dumping concrete in there as much as they could. Rutting it in and putting it in. But they've got another control structure there now. I think the Auxiliary Control Structure is finished.

Q: So they actually have two of them.

A: Two of the majors, plus the Morganza floodway. Then the Old River floodway upstream from the control structure.

Forecasting and Estimating Flows

Q: When you look at hydrology, you mentioned that you study river basins and systems. In the Corps you have an awful lot of them to study or to analyze. We've talked about the

Missouri a little bit, and we've talked about the Mississippi, are there any of the other systems that you'd particularly like to discuss. The kind of problems that as a hydrologist you've had there or the characteristics of those particular river systems.

A: Well, of course, the Columbia River is another, the Ohio and the Columbia are two other big problems. The North Pacific Division, Dave Rockwood, when he was up there developed what they called the SAAR model, which was a complex runoff forecasting model based on information on rainfall and snow melt over big basins, large basins like the Columbia. The Willamette drains into it as well as a lot of other big rivers.

But they developed the SAAR model for estimating flows and predicting flows. That model was used in a lot of places around the world. In fact Dave and some of the people that worked for him used to go to other countries and explain how the model worked and help other people develop their own models similar to that one.

So it was one of the, I guess, one of the big early forecast models--I guess we've talked about the forecast models before. But that was one of the ones that got a lot of early prominence because of the size of it, the big projects that were involved--all those big hydropower projects on the Columbia River. So that was used in their early water control center that we talked about before.

They got a lot of publicity on their capabilities to do that sort of thing. Turned out that Dave was spending about as much time talking about his model to other people as he was using it in the Columbia River. So he got a lot of publicity out of that.

The Ohio River is another serious problem. We had more navigation problems there than flood control. Even though there are a lot of levee projects along the way, there were an awful lot of navigation problems on the Ohio River. It seemed like every year there were problems with ice jams and barges getting frozen in and blocking the gates, low flows, and water quality.

Sediment and Debris

Let's see, what were some of the others--the Arkansas River, of course. It's a big problem because of the sediment down there. [There was] a lot of sediment going down the Arkansas River and trying to design flood control works and navigation works on the Arkansas River was a big problem because how did you handle all this sediment. So there was a lot of study and research done on how to design projects so that they would take care of the sediment in a manner that you could live with and still make the projects work

WES got involved in a lot of that work in trying to design the right kind of gates and so forth.

Q: Would experience working on that river, the Corps' experience working on that river, have alerted you a long time ago to these problems? I mean, if the work was done on the Arkansas River and the whole system out there, would they have known from the 19th century, the early investigations and surveys that were done, that this was a problem or was that something that just came about recently?

A: Oh no, they knew about the sediment problem. They've known about it, but what to do about it--that is, if you could do anything about it. How to design the projects, how much extra storage do you need in these projects if you're going to make them functional for a long period of time. How much of that sediment is going to stay in the reservoirs and how much of it is going to move on through. Trying to design for that sort of thing is a tough thing to do because the people didn't know enough about it. So they come up with a lot of new technology.

Q: Was that sediment problem repeated in any other major river basins?

A: Well, the Missouri River has a lot of sediment problems. Oh, what's the name of the community there. They had to relocate a whole community. Oh, Niobrara [Nebraska], that whole community practically had to be relocated because of the sediment accumulation in the headwaters of the reservoir. I forget which reservoir it was, it was one of the mainstream reservoirs [Gavins Point].

As the water flows into the flat pool, it spreads out and slows down, and the faster the water is flowing the more sediment it can carry. When it slows down, it drops the sediment. It was dropping it right there at the headwaters of the reservoir. So as it built up, it just starts getting built up higher and higher, and so it couldn't pass flow there without getting pretty high. When the flow did come in, then it would flood out the communities up in that area. The sediment was actually restricting the flow in the Niobrara River.

So they ended up relocating that whole community as a mitigation measure for the project. But they hadn't planned on it, originally they didn't have that in mind. But as it become more and more prominent, why they saw they were going to have to do something about it, and they finally did [relocation completed in 1977].

Q: What happens when you have to do something like this on these structures. Do you design for that extra storage? How much more are you talking about beyond an average dam, an average one that doesn't have a lot of sedimentation problems?

A: Well, some of them don't have too much sediment problems. Others, the life of the project is diminished in a lot of cases. Now what the Corps tried to do was design a project to take care of a certain size flood. We talked about design floods for safety. The design floods for flood control are a different design flood, much smaller than the design floods for safety. Now design floods for flood control, what you're trying to do is retain the water temporarily so that you're passing non-damaging flow downstream.

You may design the reservoir so that you can take care of a 50-year flood without causing damage downstream. But if you get a 100-year flood, you have to pass some of the flow over the spillway or open the gates wide in the outlet works. But you still are having less damages than you would have had if you didn't have any reservoir there. It's just that you can't completely control the 100-year flood.

So after you exceed the design flood capacity then your level of protection is no longer a hundred percent, you start getting damage. Not only that, channel capacity changes as time goes on. If you build a big dam and you don't make major releases, the channel downstream tends to fill in and farmers keep moving closer and closer to the river. They use their bulldozers to push more material out into the channel, make the channel smaller, and it naturally gets smaller, anyway, with more vegetation.

It doesn't have those big flows to clean the channel out occasionally. So if the channel capacity gets smaller, you have to change your water control management plans so that you don't let so much water out at one time. You have to try to let it out for longer periods or do something to offset your loss of channel capacity because the larger your channel capacity, the less you have to store in the reservoir. As your channel capacity goes down, the more you have to store.

As far as sediment is concerned, we tried to estimate enough storage to take care of a hundred years of sediment. Then on top of that, we'd have the storage for the flood control. There are other purposes and other storage, so that presumably the project would be still performing it's design function at the end of a hundred years.

But in many cases, that was a poor estimate, and that reservoir either started having more sediment inflow than it had in the past or it got some unusual floods right at the beginning of the project life and so it started filling up quickly. Then you had to re-analyze your project and decide whether you still had the same kind of capabilities you started off with.

Q: What happens when these things fill up, what do we do then?

A: That's been a subject of a lot of debate. People have talked about, "Well, hey, why not empty them. As they fill up why not go in there and remove all the material. " Well, that's fine when you're talking about debris dams out in California, the purpose of those debris dams is to capture all this debris and let the flood waters go on downstream.

They don't really store the flood waters, they just capture the big rocks and trees and all that kind of debris to keep it from going down into the nice concrete-lined channels that we built through Los Angeles. If those big boulders go bouncing down there, they raise hell with the concrete channel.

So after you have a major flood of some sort, the debris dam is all filled up and what do you do with it? Well, the local people have to get rid of it so it will be ready for the next flood that comes along. Otherwise, it's not going to serve any purpose. All the boulders will go right over the top of it.

So for years the city and the Los Angeles Flood Control District had people they could give that debris to. People wanted it for fill in highways and places like that. New developments where they wanted to smooth out a bunch of valleys or something, they'd use that debris and fill in with other material, highways, and all kinds of places. But even before I retired, they were having problems, starting to find [it] very difficult to find a place to get rid of it.

So what did they do with it? If you can't find any place to get rid of it, it gets more and more expensive all the time. At first it was a giveaway. Then pretty soon people started charging you for storing it. So, anyway, that's one of the other ticklish problems you have in California. Trying to estimate how much debris is going to come with one of those storms is a tough problem because in most of those watersheds, there is vegetation in there that gets drier than hell in the summertime.

Then some camper will go up there and throws a match, and the whole thing will go up in a fire. Immediately after those fires, the capability for debris load coming down the watershed--it'll be maybe 10,000 times greater than it was the day before. So for some time until the vegetation grows back, the potential for debris coming down there is just tremendous. You can't possibly build a debris dam big enough to hold all that stuff or design it for right after a fire, you have to design it for some period after a fire, like 10-15 years, and estimate the debris from that. Design it for that because there is no way you could do it otherwise.

Q: Well, what about some of these dams on the Missouri. What happens if they fill up? What are you going to do with those?

A: You're not going to worry about those filling up.

Q: You don't worry about that?

A: Those major ones on the Missouri River, those are big suckers.

Q: You've got a couple thousand years of storage there, then?

A: Yes, you've got lots of storage on those. Those will be some of the last ones to fill up, even though there is a lot of sediment. But you see, there are a whole lot of them, a lot of reservoirs there. The ones farthest upstream, they get a lot of the sediment. The ones downstream then are the ones that get the sediment flowing in from the tributaries. But they all don't get the main sediment from the Missouri River.

Garrison Dam and Fort Peck both have a lot of storage, an awful lot of storage in them. They collect a lot of the sediment.

Q: What about a river like the Delaware, which has really got terrible problems with pollution? Do you get involved in that kind of thing?

A: The Corps doesn't really get involved except in whatever they're doing to help EPA. At one time water quality was a project purpose. You could estimate, well you kind of assumed, that whatever you spent for storage for water quality you could recapture in benefits. You didn't have a good way of estimating the benefits that derived from it, but it was kind of like water supply. You figured that if anybody wanted it and was willing to pay for it, why it was worth the money it cost.

But for a while there we were able to add water quality to projects and give some gross estimate of what the benefits would be by diluting the downstream water. People would be dumping effluent into the stream, and by putting better water in it from the reservoir, then you would reduce the contamination of the river downstream.

Some rivers may not have any oxygen in them, for example, or very little oxygen. If you put in water from a reservoir that has a lot of oxygen in it, then the fish can survive and

things like--and so you save fish lives and that sort of thing. But then after a while they decided that dilution was not a solution.

Q: Yes, we talked about that one before.

A: So we really didn't do a lot of work in water quality outside of the reservoirs. What do you do to control these people that are dumping a pollutant into the river? That's really primarily an EPA responsibility.

The Chesapeake Bay

Q: We were talking yesterday about wetlands. What about the Chesapeake, did you ever get involved with the Chesapeake, those issues?

A: Well, we had a Chesapeake Bay Model, hydraulic model, that was built. I don't know, you might have been familiar with that. Maybe you haven't been over there. Were you ever over to that?

Q: I never was, but I certainly know about it.

A: Well, that was a big expense. They did try to redo nature in a small building, in a relatively small building, and put the Chesapeake Bay in a little building and try to determine what happened when pollutants went in one area and how would they impact other parts of the bay. They got a lot of good information, but still it was at a scale where you couldn't do the kind of things you really needed to do in order to do experiments because you couldn't actually reproduce nature in that small of a scale. So it's hard to really know for sure what is happening.

They had a hard time maintaining the gauge controls, sediment and things like that, a little bit means a lot if the gauge isn't perfectly the same all the time, why then the data isn't worth much. They had some problems like that with it. But there were quite a few experiments done there, and they finally gave up on it.

But, well, the Baltimore District has been involved in activities in the Chesapeake Bay for a long time, working with the states and other Federal agencies trying to do things that would help preserve the bay and to keep water pollution out of there. But it's kind of a losing battle, I guess.

Q: Because you've got so many points of entry on the bay?

A: Can't police it all. Well, it's not just the coming in the bay but with all the boating and so forth you get a lot of pollution in from that.

But it's, I don't know, it's been a big effort. It has been for a long time to do all they can and try to figure out ways to enhance the bay and keep it pristine, or they'd like to keep it pristine, but there is no way they can do it.

Q: But as a hydrologist, is the bay a major concern to the Corps of Engineers hydrologists or has it mostly been the area's pollution problems?

A: It's primarily a pollution area, water quality type.

Q: Because it's big enough to take anything that comes in there, I guess.

A: Oh yes. Flood control wise it's not a. . .

Q: No problem?

A: No problems there, no.

More About People: Hans Einstein

Q: I want to go back and ask you about a few more people and see if you can give me some comments on them. Did you have anything to do with Hans Einstein at all?

A: No, I didn't have much to do with him. Some of the hydraulics people. . .

Q: He was more in hydraulics then?

A: He was more in hydraulics, but I never had any personal dealings with him.

Jerry Ackerman

Q: How about Jerry Ackerman?

A: Jerry Ackerman, yes I knew him. I had a few committees that I worked on with him. Now, are you talking about the Ackerman that was in MRD or are you talking about the Ackerman that worked for the Illinois State Water?

Q: No, this was the one that was in MRD, and I guess he was in OCE at one time, too.

A: He was Chief of Engineering in MRD. But I don't think he was ever, to my knowledge, he was never in OCE. But he followed Wendell Johnson, I think, or closely after Wendell Johnson was Chief of Engineering at MRD. He was a good man too.

Joe Caldwell

Q: How about Joe Caldwell?

A: He was a prince of a man. He was a kind of guy who really worried about taking care of his employees--he got to be Chief of Engineering for a while there. He really didn't have the right background for that job. He had the personality for it, but his background was primarily coastal. He designed coastal structures and that sort of thing.

He really hadn't been much involved in major darns and levees and things like that, so that he was missing a lot of the background he probably should have had as Chief of Engineering. But he really knew how to deal with people, and he could pick up on things real quickly. It didn't take him long to learn once he had a chance. But, it's tough when you go into a top position like that, it's not a very good place to be learning.

Q: Yes, it's a little late, isn't it?

A: It's kind of tough to have to be getting the basics on a lot of the things. But he was really a great man as far as I was concerned. He knew a lot of the important people in Congress because of his background down in Mississippi, Jamie Whitten mouse of Representatives, Chairman of the Appropriations Committee] and people like that, why he patted them on the back. They'd have a hearing or something over there, and he'd walk in the room and, some of the prominent Senators and Congressman, say, "Hey, Joe how ya doing?" It would make the generals feel a little inadequate.

But he got around a lot, and he knew a lot of people and everybody liked him. I don't know anybody that didn't like him. If you worked for him and he knew who you were, if you went to a retirement party or something like that, you didn't see him standing there next to the general all night. Like a lot of the top civilian people would spend most of their evening talking with the Director of Civil Works or the Deputy Chief of Engineers or something. But not Joe. He'd talk to them, but he'd spend as much time going around visiting with all of his staff and other people as he did with the most prominent people.

Q: So he came out of LMVD, then?

A: He worked at the Coastal [Engineering] Research Center for a long time. He was in charge, when it was here in Washington.

Q: Down at Fort Belvoir?

A: No, before that. Up at. . .

Q: Oh, up at Dalecarlia?

A: Dalecarlia. That was when he was in charge of it up there. I don't know--I think it moved after he left there. I'm trying to remember, I'm not sure, but I think it did.

Q: It moved to Vicksburg, Mississippi, in '83.

A: '83, is that when it moved.

Q: Well, it moved from Fort Belvoir in '83.

A: Oh, from Fort Belvoir.

Q: I think it moved down from there in like 1970 or something. Because the Kingman Building was built in 1970, and that was CERC's building.

A: Okay, 1970. Okay, well, he was Chief of Engineering a couple of years after that or a year or so after that. So he couldn't of been Chief when it was down there, I don't think. They had a tough time finding somebody that would come in at that time. They couldn't get some of the division--people who were Chiefs of Engineering in division offices didn't want to come into Washington.

At that time they weren't putting as much pressure on them to do what the Chief wanted them to do. Since then they've been a little more forceful in getting people from field offices to do what they want them to do. They tell them, "Well, you're going to move into Washington." It wasn't a question of whether you wanted to or not necessarily.

Q: That's all part of professional development or engineering career program, isn't it?

A: Well, some of them, they just pretty well twisted their arm and said, "Hey, either you come in here or you're in trouble as far as working for the Corps of Engineers is concerned."

Q: Then go work for somebody else.

A: I don't know that they actually told them that they'd fire them, but they intimated that they might as well forget about their careers in the Corps of Engineers.

Homer Willis

Q: Well, that's a relatively strong statement. How about Homer Willis?

A: Well, Homer Willis--he was Wendell Johnson's assistant. Homer was in the project development branch when he was in Washington. He had some hydrology experience when he was in the field, but he didn't really have much real technical engineering background. He was more of the project management type thing than processing reports and that kind of stuff before he got to be Assistant Chief of Engineering for Wendell.

Wendell didn't use him as an Assistant Chief. When he was gone, Homer didn't get to make decisions. There weren't any decisions made when Wendell was gone. Wendell would make them when he got back. So Homer passed the paper, but he didn't make the major technical engineering decisions at that time.

But, when Wendell retired, he tried to be a Chief of Engineering and he got in trouble with, I don't know, General Groves [Brigadier General, later Lieutenant General, Richard H. Groves, Deputy Director of Civil Works, January 1969-July 1971, I guess it was. He really worked him over the coals because Homer tried to do some things that needed to be done in Engineering, and General Groves was all over him. So he didn't get much accomplished when he was acting, and then he went down to LMVD and became Chief of Engineering down there. And boy he served under some tough generals down there, and so he just kind of lost it as far as having a lot of brass, you know, to get things done. He just didn't have the force to get things done that he had or that he tried to have to begin with.

He lost a lot of his strength, I think, when he was down there, his inner, you know, [due to] his action with General Groves. He just figured, I guess, that it didn't pay to fight generals. So I don't think he was anywhere near the kind of a Chief of Engineering that the people before him and after him had been. While he tried hard, he didn't have the right kind of a personality, and he didn't have the reputation and all that kind of stuff that he needed to do the job. So it was tough on him.

He was in there and had a bad time, too, when the dam safety program was on. There was a lot of controversy about it. People didn't look at him like they did Wendell Johnson or Slichter or any of the others. They just didn't have the same kind of respect for his judgment on professional engineering decisions.

Q: So for the time you spent in the headquarters, you seemed to be leaning toward Wendell Johnson as the top Chief of Engineering Division.

A: Well, I had an awful lot of respect for Lloyd Duscha. I worked a lot closer with Lloyd Duscha than I did with Wendell. When Wendell was in there, Al Cochran did most of the close meetings and so forth with Wendell. I didn't work as closely with him. But he had that kind of a charisma about him--Lloyd didn't quite have that kind of charisma.

But Lloyd had the technical capability, and he knew a lot about hydrology and hydraulics, even though he had never worked in Hydrology and Hydraulics. He could understand when I'd explain problems to him. But a lot of the other Chiefs of Engineering weren't all that hip on it. He was a hell of a good man all the way around. It's just that he didn't have that magnetism that some of the people have about them. He was adequate but as far as socializing and all that stuff; he just didn't stand out, I don't think, like some of the others did. Like Joe Tofani, like we were talking about.

Joe Tofani

Q: Well, there are very few people like Joe Tofani around.

A: I mean he'd walk into a room, and Joe is the center of attraction no matter where you go.

Q: Or he'll make himself the center of attraction.

A: Well, Lloyd wasn't like that. He was kind of quiet, and he could be in a room and nobody would even notice him. But Wendell Johnson was in a room or Joe or somebody like that, by God, you knew they were there. If you didn't, why there was something wrong with you.

Q: I think we're about at the end of my questions. Is there anything else that you'd like to discuss that we haven't touched on? We've touched on pretty many things.

A: Well, I can't think of anything really off hand. Somehow that theme of keeping H&H healthy and independent as much as possible is something I'd like to see continued forever, as long as they have a need for it. In our lifetime, why there's going to be a need for hydrology and hydraulics for sure. And forever.

Q: Oh yes, I wouldn't doubt that--as long as we have water and rain.

A: As long as you're trying to do anything with the water. But I have been happy with my choice of a profession. When I first started to work out of college, I had a choice of working in different areas. I decided that hydrology had the most to offer in terms of interesting work and everything wasn't cut and dried, you had room for vision, new ideas, and concepts.

Whereas, some of the other areas of engineering are more tied down, and it's more of a textbook type approach. The standards are already there, and they use certain size loadings and certain size, how much strength. Whereas in different types of materials, you didn't have to try to come up with your own concepts or anything like that, it had already been done for you as long as you knew what the rules were.

The Fort Worth District and Water Losses

But, anyway, it's been interesting, I think. I've never really been bored in any of the time I've been working in it. Even today we run into new problems and trying to figure out how to do things. We've got a tough one right now we're working on with the Fort Worth District, trying to do the right kind of hydrology for a river basin down there which has some apparent large losses, which the district is having a hard time recognizing. We're having a hard time trying to decide what they should be because we don't know enough about the local area except we do know there are major problems with trying to get a good frequency analysis down there.

Q: What do you mean by major apparent large losses? Is it water?

A: It's the water. There are some streams where there are underground canyons, like almost where a lot of the water will disappear from the river and then reappear later on downstream. So there is an underground channel there someplace, flowing underground, and these can be large quantities of water in some places. But this one we don't know enough about to know what it is. Nobody has really got into it to check it out in great detail or anything.

But we see by looking at the historical flow at the gauge upstream and then we look downstream and there hasn't been enough *rain to cause an increase in flow. Yet the flow downstream from this station is much greater than this one. Where is the water coming from? Well, there was a lot of flow up here. It seemed to disappear when it got here and then reappear down here. Trying to figure out just how much it's going to be under different circumstances and that sort of thing when you don't have much to work with, you're doing a lot of guesswork. You're trying to develop a model that will show this stream up here with a lot of water and then less water here and then more water back down here, and it doesn't follow your normal run-off procedures, where so much rain falls on the land and you estimate the losses and then you make a hydrograph out of it. You have procedures for doing all that. But you don't really have good procedures when the water disappears and comes back in.

Q: Now what river is this?

A: This is the Ciblo River down in Texas. But it's an interesting study, and Fort Worth District wants to approach it one way and we think that maybe they ought to try another way. We're trying to get them to do a little more than they want to do. It costs money

to do it. It takes a lot of time and effort, and FEMA isn't giving them enough money to do all of the stuff that we'd like to see them do. So I don't know how it's going to come up.

Q: That's the kind of thing you were talking about though--it keeps you interested.

A: Oh yes, it's a challenge to figure out how we're going to solve this problem, how are we going to get together on this thing. How can you come up with convincing arguments for doing things and give them enough information, enough evidence, to say, "Hey, this ought to be studied and that type of thing." So it keeps you really on your toes, even after you've been fooling around with the stuff as long as I have, you're still running into new things that you haven't had a chance to study or look at before.

Part of it is just having data to work with. In this particular project, why we didn't have hardly any data to work with except a few stream flows. But since the Fort Worth District has been working on it, they've submitted the material to us with reams of basic data that we could work with and puzzle over and try to decide what way to use it. It may be different from the way they use it.

But in this particular basin, they have three or four counties that all have different ideas about what they want for a floodplain. Some of the communities want to be real restrictive and have a high, a big 100-year flood. Others don't want to be restrictive, and they are not going to have the flood large. One county down there passed a law and said this is going to be the 100-year flood, even though they didn't really know how they got it. But, I think, they were quite a bit bigger than some of the other people. They said this is it in our county. So you can't build anything below this level.

What we're trying to do now is, or what FEMA is trying to do, is resolve these differences so that you don't have one flow when it's going through this county as the 100-year flood and then when you leave the county boundary; it jumps way up. So those are the kind of problems you run into.

Well, they had some pretty prominent people make suggestions on how to solve the problem. Who knows which one is right, or if any of them are right, on how to do it because none of them had spent a great deal of time. They come up with statistical procedures that are different than the other guy's statistical procedure and say, "Well, this will do a better job of representing the data than the first one." How could you prove that it does?

What we're trying to do is study the problem from more than one angle and then come up with a composite answer that's reached by adjusting and modifying both approaches until they merge together into the same answer.

Q: And then you get them to accept it?

A: And then get somebody to accept it, get everybody to accept it, you know, that what you did was the best way to do it.

Q: Which is the greatest challenge you're going to have?

A: Well, of course, FEMA really has the ultimate authority here in saying, "Well, this is what we're going to use." Then if anybody doesn't like it, they'll have to take them to court and prove they're wrong and that's hard to do. But still, they'd like to have as good an answer as they can get without spending a fortune.

Q: So it comes down to dollars?

A: Oh yes. There is not unlimited resources in any of these agencies or projects.

Final Thoughts

Q: Anything else you want to talk about. As I said, you're going to have another opportunity at this, so this isn't the end of it.

A: Well, I'll get a chance to review it, and hope I didn't say anything too derogatory about anybody.

Q: I don't think so, it doesn't sound like it.

A: I mean the people that work for the Corps, by and large, most of the ones that I've run into were all very competent people. If they made mistakes, they were honest mistakes in most cases. Oh, once in a while you'll find somebody that did things deliberately to serve a purpose. But sooner or later they usually get found out, and they fall by the wayside.

This business of government employees being lazy and not competent and all that stuff, I've never run into that in the professional side. Most everybody that I run into were pretty conscientious and intelligent and really wanted to do their job right.

Q: Well, there are enough organizational levels and layers in the Corps that the good people will naturally percolate up, I think. This whole professional development program that they have for engineers with the levels of responsibility and the movement of people around is a very good program. I think that's a very good idea.

A: It worked out before somewhat like that, even kind of on an ad hoc basis people would get their own training by moving around because they couldn't get a promotion here. They'd say, "Well, how do you get promotions." The way to get promotions is to move to another office because the office you're in, they think you're going to stay there forever.

You can threaten to leave and that doesn't make any difference. Then after you tell them you have a job someplace else, "Oh, you shouldn't have left, we would have given you a promotion here." But that's the way it works, so that there are a lot of people that have to move around to different jobs just because they were trying to advance their career.

But the people that were so intent on staying in one location, they didn't usually advance very far. They had to really be outstanding to advance and stay in the same place because there was so many people willing to move to another location.

Q: Who had a variety of experience?

A: Oh, I was really fortunate when I was in Garrison District before Icame into Washington because when I got in that Hydrology and Hydraulics Branch, I worked in the hydrology section for awhile doing all different types of hydrology studies. Then I moved over into the report section, which was really a planning job, and I worked there for a while.

Then I moved in the hydraulic design section and worked there for some time before I finally went into Washington. So I got really a good variety in a relatively short time, which most people don't get. Usually, you get stuck in one area and you have to stay there for quite a while before you get any new experience.

Q: Yes, that's a valuable thing to have, that breadth of experience early in a career.

A: Well, I think that's one of the reasons that Al hired me without even talking to me, because I had had enough experience in various types of hydrology and planning and that sort of thing before I ever came into Washington. So I could review projects and know enough about them that I could make the intelligent choices.

Well, I hope you get enough information here--I've always thought it was kind of a shame that people with all this knowledge, like Al Cochran and some of them, really didn't get their ideas and thoughts and so forth on tape or paper some place so that other people wouldn't have to make all the mistakes they had to or that they had to go through.

Q: Well, this is a new effort. Though they were working on civilworks people before, they had not made an effort to really work on the people in hydrology and hydraulic engineering at all, especially hydrology. So there are many more that we're probably going to be talking to. I have the names that you gave me.

A: Well, there are a lot of them around yet--maybe not working in the business anymore, but they still have their memories. Maybe a lot of them have collections of material that would be useful.

Q: No, we're going to go after them. I want to thank you for your cooperation.

A: Well, I've enjoyed talking about it. I know Jake [Douma] before he retired [said], "You know it's too bad that the Corps doesn't have some plan where they can take guys like me and let them have an office, some space, in the office. Don't pay me any money but let me come to the office and work on things that I'd enjoy working on and do things I want to do. I would contribute to answering questions and things like that and all they'd have to do is provide me some space," he says. "I could come and go when I felt like it. I think that would be a good thing for the Corps and carry over information and concepts from one generation to the next."

Q: I think these interviews will do that because they will be useful. A lot of them will be printed and published, and they'll be used for study, too.

A: Well, the job I have now is kind of like this thing that Jake was talking about. Dewberry & Davis pays me for sitting at a desk and working on special projects and having the young engineers, when they don't know how to do something come and talk to me and

find out how to do it. I give them my ideas on how to do it, and then they go ahead and work until they're stuck again and then they come and ask more questions.

Personally I find that it's better training for them than to give them a formal course on various aspects of hydrology that they may not be using for a long time. So what I try to do is give them good information on a particular problem that they're working on so they can learn that particular problem.

Then when it comes time for the next problem, why we'll teach them about that one. Because you can teach them a lot of stuff they never will use and spend a lot of time doing it. By the time they come around to using it, they may have forgotten everything you told them in the first place.

Q: Yes, the practical things they will learn and will remember rather than the book learning.

A: And they have to do it and do a little book learning on where the technology is published.

Q: Thank you very much.

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