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Chester 7- March 1978

Stenographic Transcript of
Witness Marvin Granstrom

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SUPERIOR COURT OF NEW JERSEY
LAW DIVISION - MORRIS COUNTY
DOCKET NO. L-42857-74 PW

March 7, 1978

FILED
APPELLATE DIVISION
JAN 30 1979
CM
Elizabeth McLaughlin
Clerk

JOSEPH CAPUTO and
ALDO CAPUTO,

Plaintiffs

-v-

STENOGRAPHIC TRANSCRIPT

FILED
JAN 14 1980

TOWNSHIP OF CHESTER,
PLANNING BOARD OF CHESTER,
et als.,

Defendants

CLERK

REC'D.
APPELLATE DIVISION
JAN 30
EK
Elizabeth McLaughlin
Clerk

BEFORE:

HONORABLE ROBERT MUIR, JR., J.S.C.

APPEARANCES:

For the Plaintiffs: PHILIP LINDEMAN, ESQ.

For the Defendants: ALFRED L. FERGUSON, ESQ.
AND
JAMES L. HILLAS, ESQ.

Frank E. Nolan
Official Court Reporter

PENGAD CO., BAYONNE, N.J. 07002 - FORM 2046

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I N D E X

WITNESS	DIRECT	CROSS	REDIRECT	RECROSS
DR. MARVIN L. GRANSTROM				
By: Mr. Lindeman	13			
By: Mr. Ferguson		77		

E X H I B I T S

NO.	DESCRIPTION	FOR IDENT.	IN EVI.
D-81	State Development Guide Plan Preliminary Draft, Dated 9/19/77.		7
P-48	Curriculum Vitae.		14
P-49	Report.	20	155
D-37	Report.		155

THE COURT: All right. Proceed.

MR. FERGUSON: I am not sure who goes first. Correspondence to the Court indicates that Mr. Lindeman and I have agreed, subject to Court approval, to mark the State Development Guide Plan into evidence. I do have the specific pages and paragraphs to which I would call the Court's attention.

I think the burden of the Court will be substantially lessened by what counsel has perceived and at the Court's request for written findings or proposed findings.

THE COURT: Let me say this. I will allow it to be marked in.

But every day you add in documents is going to be that much longer before a decision comes down and it makes it very, very difficult for a trial judge to go through reams and reams of evidence. I know your philosophy on it and I disagree with it. I do not think that the record should be encumbered with lots of theoretical concepts and that is basically what you are giving me.

I am dealing with the Township of Chester and I am dealing with a new area of the

law, as I see it, and I very frankly and with no offense meant, I object to having to sit down and read and read and read and go over these theoretical documents when I am dealing with practicalities. There is nothing that relates specifically to Chester that is significant and that I have not already been told about, or should have been told about by now or must have been told about by now.

MR. FERGUSON: I appreciate the Court's concern and I am certainly not going to press all the other documents which we have marked and which the Court has declined on that basis. This is a State Development Guide and the Supreme Court in both the Mount Laurel and Madison Township cases said that this is really the province of an overall state entity, whatever that may be, and if the Legislature had acted and if we didn't have the problem in a vacuum without legislative guidance, then, we would not have to act.

THE COURT: But we do not have legislative enforcement of that.

MR. FERGUSON: That is true, but this appears to be the most recent and most

authoritative pronouncement of where the State might be going.

THE COURT: May I make a parallel to it?

MR. FERGUSON: Yes.

THE COURT: In 1951 the State said where Route 24 was going to be. It said it was going to come up through Essex County and come into Morris County and go around Morristown and go out and end up in Phillipsburg. That was in 1951. It is now 1978 and they are having a debate now as to what is going to happen and where it goes as it comes out of Essex County.

Now, I realize that the future is a long way off in some of these things. I have to deal with the present. I have to deal with Chester Township for five or ten years at best. I cannot deal with Chester Township in the year 2000 or the year 2050.

MR. FERGUSON: I do not know when this is going to be implemented.

THE COURT: That is the thing. It may be a guide, but I cannot deal with theoreticals.

MR. FERGUSON: But, you see, part of the validity of the planning testimony is in

part judged by other similar projects and plans.

THE COURT: Yes, but on short range and with some evidence of the current reliance on it. I do not remember specifically and I cannot say since I have not reviewed the notes that I have taken, except in the preliminary stages, but I cannot recall how much reliance there is on this document.

MR. FERGUSON: In the planning process? None. It is too recent. It is an add-on and was not available at any prior time.

THE COURT: I will do this. I will allow you to mark it in evidence if Mr. Lindeman has no objection, but I do not intend to spend a great deal of time reviewing it. If you just want to have it in the record so that in case it gets to the Supreme Court that the Supreme Court can look upon it, fine, but if it has such tangential relationship as being a new plan by a group, as far as I know, that has no legislative authority to tell Chester how it is going to zone. I just question severely its relevance to this case.

MR. FERGUSON: I certainly will accept

that, your Honor. By the time this case could get heard on appeal, this could either be of no validity whatsoever, or it could be the document that changes their minds.

THE COURT: I am just not going to spend a great deal of time reviewing it, though, and I just question seriously the relevance of it.

MR. LINDEMAN: If your Honor please, I will not violate a commitment I made to Mr. Ferguson. I have really abdicated in favor of expediency, which I think falls on the Court as a heavy burden. I understand that, but I just say that I would not object simply because I think to object would take more time for me, but I can see what it will do to the Court.

THE COURT: All right. I am willing to work when I have to work, but I am not going to do extra work when I don't have to do it and what I consider making work. When I get to the position in this job where I have to make work for myself, I am going to quit.

MR. FERGUSON: Yes, sir.

THE COURT: You may disagree with my approach on that, but I am not going to make

work for myself.

If you want to mark it in evidence, fine, but as I pointed out to you, I will not spend any significant amount of time. I may make a footnote on it, if I write an opinion, or I may refer to it very tangentially if I find it necessary, but in all probability it will pass by without mention.

MR. FERGUSON: I think that is a fair approach that the Court is taking as to the weight and the time the Court should spend on it.

THE COURT: Okay. Then, it can be marked. I did not want to mislead you gentlemen when I let it be marked into evidence. I do not think that is fair.

You may mark it as D-81 in evidence.

(State Development Guide Plan, Preliminary Draft, dated September 19, 1977 is marked D-81 in Evidence.)

THE COURT: On the record and while we are on that subject of pointing it out to me, I decided after I started reviewing the minutes and trying to condense all my notes as to what the witnesses did testify to, et cetera, that I

thought it would be appropriate if both of you file with me, all of you I should say but I assume the Planning Board is riding with the Township, file with me all of the facts and state all of the facts that you allege you have proved as to what plaintiff is seeking and in all respects, and as to defendant as to all of its defenses and what has been proven and what has not been proved, which would sustain your respective positions.

I assume that both of you who have practiced in the Federal Courts on complex litigation that this is one of the facets suggested in and followed, as far as I know, by some of the Federal District Courts and which come out of the Federal Reports, Annotated, and I think it was a number of years ago, but it was documented and it is a procedure followed to assist the trial judge in determining what you say you have proved factually and by whom and, then, you can give your summations in writing along with that, but I am looking for your factual proofs. In other words, my explanation to attorneys in the past when I sat in the Chancery Division was that you are

going to write the Court's opinion. I know you are not going to, but I know this is the theory of it: How would you write it and what would you prove to sustain your positions? Then, the identifying facts that you have established and who you established them by. I am not going over all of it now. As a matter of fact, I take these home with me every night. Some nights I can go through them and some nights I do not and I am condensing all of the testimony down and I am identifying what has been proved by physical witnesses. You are going to tell me those facts that you have proved by those witnesses and how they lead to the conclusions that you seek.

MR. LINDEMAN: Do you mean by that, Judge Muir, that we are not to pay so much attention to citations of the authorities to support us?

THE COURT: No. I am not concerned about citations of authorities. I am concerned about facts. You are seeking to establish, in other words, that Chester is a municipality within the concept of Mount Laurel. So, you should show me those facts that you have proved.

I think I have most of the facts that you have relied on.

MR. LINDEMAN: I am sure you do, too.

THE COURT: But I would like to know from your position and, very frankly, it is of great assistance to me. I do not want to suggest that I am infallible because I am not and I make mistakes. One thing that I feel that a trial should do is give even the losing parties his fair share of the facts so that the Appellate Division, if the Appellate Division wants to say that I am wrong, that I have got a fair share of the facts. It is not fair for a trial judge to take the facts and shave them and leave out the other side's proof. This is an assistance.

MR. FERGUSON: May I make an economical suggestion? Would you want each proposed fact in a separate paragraph with the number and each paragraph on a separate page?

THE COURT: It would be helpful, if you can do that.

MR. FERGUSON: From your point of view it might be helpful to have them separated so that you can shuffle them or organize them.

THE COURT: As I said, what I am doing now is going through and structuring each testimony. Then, I have got all the points that each of you have laid out on a piece of paper and I will laboriously go through all of these structured facts that I have taken that I see you have produced and put the facts under each point, and what facts are in support of you and what facts are in contravention of this position and I end up using a pad of legal paper and I go on and on and on. Then, what I try to do is to structure my opinion based upon the cases that I have read and I think of what the cases say.

So, I would like to see from your standpoint what you think you have proved as to each one of your points and your respective positions because those points should be in my outline from where I am going to take the facts and fit them in, but the numbering of paragraphs as they relate to specific aspects of the case would be helpful because, then, as I go through it I could examine it out. If you intermingle them, I have to line out the parts of sentences and leave in another part of

a sentence to see if you in fact have proved or if you feel you have proved it, but I feel it is controverted or I feel that I cannot give you the amount of weight to it that you feel should be given to it, or I do not feel credibility was there. Then, I have to rule on that aspect, but it is very helpful in a sense of it is my responsibility to give, as one of the trial judges has indicated and is inclined to describe it, to give the devil his due and he suggests that the devil is the loser. The devil should be given his due and all the facts that he has proved and give it to him in fairness to his case. This is why I feel very strongly about it and this will be helpful, particularly in a case going on like this.

Now, the amount of time involved in this is what I wanted to touch on with you next. Well, maybe we will take your expert and let us do that at the end.

M A R V I N L. G R A N S T R O M, sworn.

MR. LINDEMAN: If it please the Court, Dr. Granstrom is an environmental engineer and his expert testimony is offered by way of

response to that portion of the testimony of Messrs. Lloyd and Professor Kean and others, relating to the impact of residential construction or other construction in a sensitive environmental environment.

We took the position, of course, when the testimony of Mr. Lloyd was adduced that it came as a surprise to us because Mr. Lloyd had testified at the pretrial discovery that he did not relate the impact of construction upon the pollution or contamination that you found in the environment and, particularly, in the streams which flow through Chester Township; and following our objection the Court offered to permit us a certain amount of time in which we could develop our own testimony, which has been now done.

We continue to object because we think we have not had sufficient time to fully develop this part of the case, but we are proceeding anyway.

Dr. Granstrom will testify, among other things, as to the location of the present R. M. zones in this so-called environmentally sensitive area, the water shed area of Chester

Township, and what effect if any that location has upon or may have upon the environment and, also, that it is possible, if not probable, that a multi-family dwelling complex can be constructed in an area such as Chester Township and with perhaps equal or, in any event, no more damaging impact upon the environment than single family dwellings which are presently allowed by the zoning ordinance.

That therefore in broad outline will be the nature of Dr. Granstrom's testimony. Now, if your Honor please, I did furnish to the Court and to Counsel what is designated as a resume which is of course a curriculum vitae for Dr. Granstrom. I would like to have the witness offer testimony about his qualifications, but at the same time offer this.

THE COURT: That will be marked as P-48.

MR. FERGUSON: No objection.

THE COURT: Mark it P-48 in evidence.

(Curriculum vitae marked P-48 in Evidence.)

DIRECT EXAMINATION BY MR. LINDEMAN:

Q Would you tell us please what your profession is and what do you call yourself?

A I call myself an environmental engineer.

Q And would you in the course of your testimony please keep your voice up as much as possible?

What is your educational background both as an under graduate and graduate degrees?

A I am a graduate civil engineer when I was at Ohio State University. I have a Master and a PhD degree in sanitary engineering from Harvard University.

Q And your under graduate degree was in 1943 and your Master was in 1947 and your Doctorate in 1955?

A Correct.

Q What educational honors were awarded to you and have been awarded to you, Doctor?

A Tau Beta Pi and --

THE COURT: I take it that these are going to be read from the curriculum vitae? Unless it is necessary by Mr. Lindeman, perhaps we could just stipulate that he is going to testify to this and you can highlight it. It might save time and I know it is going to save my Court Reporter's knowledge of the Greek alphabet.

BY MR. LINDEMAN:

Q Tau Beta Pi is in engineering?

A Yes, sir.

Q What is Chi Epsilon?

A Honors in civil engineering.

Q And Delta Omega?

A Honor in public health.

Q And in your teaching experience you show in 1947-1949, when you were an instructor in civil and sanitary engineering, at what appears to be a mistyping, is it not? That should be at the Case Institute of Technology?

A Correct.

Q And presently you are a professor of civil and environmental engineering at Rutgers?

A Yes.

Q Would you tell us what your courses are and curriculum is at this time?

A The courses I teach are both undergraduate and graduate levels, predominantly the number of courses are in the graduate level.

I teach those courses listed under the curriculum vitae and the resume reads as follows: Water supply, sewage, hydrology, public health and hydraulic operations, water treatment plants, design of sewage treatment plants.

Q Now, what if any experience do you have

now, or have you had in the actual practical design of sewage treatment plants?

A In the states of South Dakota and the state of North Carolina, I was actually engaged in the design of treatment plants as a design engineer and in New Jersey part of my designing experience has been as consultant to designing engineering firms.

Q Now, you are a participant as an educator in evaluating graduate students on their thesis and their work in graduate degress, are you not?

A Yes, sir.

Q Would you tell us what kind of committees you sit on and for what level of degrees?

A At the present time I am senior advisor or graduate advisor to four doctorate degrees.

Q In what fields?

A In general sewage treatment research and stream pollution control research and in the economics open to my situation the techniques for sewage treatment plant procedures, and stream sanitation surveys. I believe that covers it generally.

Q Do you sit with General Whipple as one of the members of the faculty in reviewing these candidates?

A Yes, sir.

Q The General Whipple having been a previous witness in this case on behalf of the defendants?

A Yes.

Q I am not going into all of the other items of the curriculum vitae because I think they are generally self-explanatory, and there are the publications of the witness as shown on the last page of the exhibit, P-48, and I therefore offer the witness.

MR. FERGUSON: No questions.

THE COURT: Is there any objection to his testimony?

MR. FERGUSON: No, sir.

THE COURT: Okay.

MR. LINDEMAN: Now, if your Honor please, while I was away last week we had received a preliminary and badly typed and misspelled report that had been prepared for the witness, which he had not even seen and, certainly, I had not even seen, but it was sent to the Court. I apologize for having done that, but I am sure the Court did not read it anyway.

THE COURT: I did not read it. So, do not apologize.

MR. LINDEMAN: But I have already

furnished a copy of the corrected report to counsel and I think I can state fairly accurately that the witness will testify pretty much from it as the document is written and might therefore be of some help to the Court, if it had a copy of the document as it was going into evidence.

Unless there is an objection, I would ask that the report be marked at this time and that the Court see a copy of it as the document progresses.

MR. FERGUSON: I will state my problem, your Honor, and then I think we can no doubt deal with it.

The problem is that some of the evidence that this witness is going to give relies on documents which are not in evidence and, indeed, they were excluded, such as the Environmental Impact Statements because part of this witness's testimony, as I conceive it, is to the effect that it is possible to build what Mr. Caputo wanted to build without environmental damage, and that the Court has already ruled is without the scope of the present litigation. Other parts of the witness' testimony are clearly in

rebuttal to General Whipple or Mr. Lloyd.

So, as to the entire report I have problems with it, but those portions of it which are clearly in rebuttal, I have no objection to.

MR. LINDEMAN: If your Honor please, we did follow the rule in Mr. Lloyd's testimony that the report went in and even though there were certain parts to it to which there were specific objections, the Court ruled on them after the testimony was received. So, perhaps, if you follow the same procedure this time, it might be of aid to the Court.

MR. FERGUSON: That is satisfactory to me.

THE COURT: All right. Let us mark it, then, for identification.

(Report marked P-49 for Identification.)

BY MR. LINDEMAN:

Q Would you describe please the placement of Morris County in terms of the location of the water shed and refer to the report as you understand it and know it?

A Right. Morris County is located on the upper reaches of the Musconetcong-Raritan-Passaic-Whippany-

Rockaway-Pompton-Pequannock Water Sheds.

Q And those names refer to various rivers?

A Correct.

Q And do those rivers serve as water supply sources for the area of Morris County and other counties in New Jersey?

A Yes.

Q They do?

A Yes.

Q Now, what if anything should be done about preventing those rivers from becoming polluted in terms of their use as sources of water supply?

A Well, the pollution should be reduced to a minimum.

Q Now, you are aware of course of the fact that the defendant in this case is Chester Township?

A Yes.

Q In Morris County?

A Yes.

Q Do you know where it is located in Morris County?

A I do.

Q And can you tell us whether or not the defendant is in a water shed area?

A The defendant is in a water shed area of the Raritan River.

Q And is that Raritan River one of the sources of water supply for the citizens of this state and other states?

A It is.

Q Now, as to the plaintiff's tracts, the Caputo tract, is it in a water shed area which is just the Raritan Water Shed, or are there other water shed areas that can identify its location?

A Well, it is in the Raritan, but the upper reaches are in the Peapack Brook.

Q And the Peapack Brook is a water shed?

A It is a tributary to the north branch of the Raritan River.

Q You are familiar, are you not, with the zoning of the Caputo tract as it presently exists under the zoning ordinance of Chester Township?

A Yes, sir.

Q What are the lot sizes as you understand it of the Caputo zoning?

A Approximately the northeast quadrant of the lot, the tract is zoned for two acre lots, and the remainder for five acre lots.

Q Now, have you examined the location of the three so-called R.M. zones?

A Yes, sir.

Q In Chester Township?

A Yes, sir.

Q Have you examined the zoning map and noted particularly where those properties are?

A Yes, sir.

Q And have you also noted their location in terms of the location, if you will, of streams and other water source areas?

A I have.

Q And would you tell us where those three parcels are located in terms of the water shed areas, and we will refer to them as the far western, center, and the eastern zones?

A The western area is a tributary to the Black River. It lies on that area tributary to the center and 40 per cent of the eastern, approximately 40 per cent of the eastern R. H. zone are in the Peapack Brook water shed.

Q Now, is it also a fact that in connection with your previous testimony that all three of them are in the Raritan River water shed area?

A That's correct.

Q What streams if any are in any proximity or close proximity to any one of these three parcels?

A The three parcels actually lie tributary to the

stream and the center lies almost at head waters, or one of the tributaries. I cannot remember the exact name of the tributary. I say the north branch and so forth.

Q I show you a copy of Mr. Lloyd's report, which contains a page showing the tributary system. Does that help you?

A Yes. The center zone is tributary to the north branch and the eastern zone is the R. M. zone, which lies astride the branch to the east of the north branch, which is unnamed on this map.

Q Un what?

A Unnamed.

Q Now, Doctor, have you studied the impact on the environment of the effect of the design and governmental control of multi-family developments and the impact on the environment of single family developments?

A Yes, sir.

Q Now, which type of development, as a general proposition, is the subject of control, either by government or local law or regulations, of multi-family over single family?

MR. FERGUSON: Your Honor, I object because I really do not understand the question.

THE COURT: Could you rephrase the question?

MR. LINDEMAN: Yes. I will.

I think I will withdraw that question at this time and we will come back to it later.

Q You prepared a report which is marked P-49 for identification. Can you tell us what the purpose of that report is with respect to the multi-family development, as compared with single family developments in the municipality such as Chester Township? What is the purpose of the report?

A The purpose of the report was to compare the possible impact of these two different types of developments on the water bodies in the Peapack Brook and tributaries.

Q Now, as to the subject of sewage disposal, would you tell us please what kind of sewage disposal system is likely in a single family development area such as the single family development areas in Chester Township?

A These are and most likely will be individual sewage disposal systems and they probably will be septic tanks and there would be drained fields.

Q Would you describe a septic tank in terms of their construction and operation?

A A septic tank is a tank which has a specified size of approximately 700 gallons for a single family dwelling and the sewage goes into one end and comes out the other, the objective being settlement of sewage material at the bottom of the tank and the settlement material decomposes in the so-called anaerobic digestion process. There is considerable scum formed on the surface of a septic tank because of the flotation of the settlement material due to the evolution of gases during the anaerobic digestion process.

Q Now, what happens to the effluent from the system or from any septic system when it emerges from the system itself? Where does it go? What happens to it?

A There would probably be a drained tile field, a water tile field. The water seeps through and between the adjacent tiles and soaks into the ground.

Q Then, what happens to the effluent when it gets into the ground?

A Well, it seeps into the ground and either becomes part of the ground water or, of course, a certain part of it would be taken up for the growing of plants during the growing season. Water is available for that purpose.

Q Now, can you tell us what the proper

maintenance program for a single family septic system is or should be?

A Every few years the septic tank should be examined and solid material pumped out, and there are firms that do this commercially and carry the solids away and dispose of them in some manner appropriate to their particular pilot program.

Q Do you know if there is any governmental law or regulations or statutes which directs that septic systems for individual home owners be pumped out in any regular pattern or basis?

A No. There is not.

Q There is not?

A No.

Q There is no such law or regulation?

A Not to my knowledge.

Q Is there any law or regulation which controls the operation and maintenance of a system such as a sewage treatment plant for large developments, such as a spray irrigation system?

A Yes, sir.

Q There are laws and statutes that regulate such maintenance?

A There is.

Q Now, do you know if in examining the

reports that you relied upon, in particular that of Mr. Lloyd, whether or not there have been any reports of either mismaintenance or poor control of the septic systems in Chester Township?

MR. FERGUSON: I do not quite understand the question.

A Pick out the reports from Dr. Lloyd's report?

Q Yes. Pick out the statements from Mr. Lloyd as to the maintenance of septic systems in Chester Township.

A Mr. Lloyd testified that there had been a degradation of the water quality in the Peapack Brook over the past decade. He also indicated that there were approximately 500 additional persons living on the water shed and he attributed in part the degradation to the poor quality effluents from the septic tank sewage into the water. This was on Page 43, center paragraph. He says that more detail can be found in the tabular data which is appended to his report.

Q Now, when a septic system is not pumped out properly or sufficiently, what consequences, if I may use the word, flows from that?

A There would be a solid carryover. The solids could clog up the drain field and the water simply has

to seep out of it and oftentimes reaching the surface of the ground, this water being essentially raw sewage.

Q Now, do you know what kind of a multi-family sewage disposal system is feasible for the development of a multi-family operation such as is shown on Exhibit P-2 in evidence? What kind of a system is feasible without describing it in detail?

MR. FERGUSON: I object at this point. I think we are getting into an area, or I will ask counsel if we are getting into an area of having this witness testify about what is proposed for the site?

MR. LINDEMAN: If your Honor please, I think the witness and I have taken and I expect that he will take pains not to testify from an environmental impact statement. It is a document which the witness shows he has read and studied, but we are not going to justify this whole system as such. We will, however, refer to the fact of spray irrigation, as did Dr. Patrick in her testimony, and we will refer to the effect, if any, of the construction of a lake serving as a retention or detention pond, and that was referred to by General Whipple and by Dr. Patrick and by Professor Keane, as

well, but we are not going to talk about 956 units and where they can be located and just exactly how the stream is going to be damaged up and all that kind of thing.

It is going to be on a general and theoretical basis.

THE COURT: You are attacking the zone property on the theory of environmental concepts?

MR. LINDEMAN: Yes.

THE COURT: All right. I think he has a right to do that.

All right. Go back to the last question.

MR. LINDEMAN: I will repeat the question, your Honor.

Q Do you know what kind of a multi-family disposal system is feasible in this kind of area and in an area such as the Caputo tract in Chester Township?

A Septic tanks would certainly not be feasible. Therefore, a sewage collection system will be required. A sewage collection system would require as a minimum a so-called secondary treatment, which is a rather complete treatment followed by disinfection by the use of chlorine.

THE COURT: Followed by the use of what?

THE WITNESS: Of chlorine.

Following that and in view of the fact that the Peapack Brook is a small brook and in view of the fact that the testimonyhas shown of the degradation of the Peapack Brook downstream, the Peapack-Gladstone Sewage Treatment Plant there, it would be most feasible to use a so-called tertiary treatment to provide additional removals from the sewage and a most practical and acceptable scheme would be that of spray irrigation.

Q Now, would you tell us, please, what the operation of these various stages of the system are on a theoretical or a general basis, that is, a collection system? Just what do they do and what funcations do they perform?

A Well, a collection system simply carries the sewage from the house to the treatment plant and to the building of the treatment plant. The treatment plant itself would consist of three basic components, one being the so-called primary treatment, which is comparable in fact to a septic tank. Then the next process would be the so-called secondary treatment process in which a biological system is employed to remove the majority of those components, organic components, which are not removed in the primary

tank.

The relative numbers would be as follows: The primary tank would remove about 35 per cent of the organic pollutants and the total process, including the secondary, would remove 90 per cent of the organic components. That sewage, then, as it leaves the secondary process would be chlorinated in the specifics for the detention time and the residual amounts are given by the New Jersey Department of Environmental Protection. That chlorinated sewage would then be separated onto the spray irrigation area and the spray irrigation area would have by the New Jersey Department of Environmental Protection requirements the monitoring by the Department as well as monitoring by the operator of a treatment system, also.

Q Is that it?

A Yes.

Q If the Department of Environmental Protection, or whatever other agency has jurisdiction, should find that there are corrections or deficiencies do you know if the Department of Environmental Protection now, for example, has any authority to require correction?

A They do.

Q Now, what effect or what does the sewage

from the spray system do to the ground water supply, if anything?

A Insofar as the water that spreads onto the land and sprayed onto the land, it seeps down through the soil and the heavy metals which would consist of such things as lead and zinc and copper and mercury will be adsorbed onto the surface of the soil for the first few inches of the soil. The phosphorus would be temporarily retained on the soil surface, as would the nitrogen and those nutrients such as phosphorus and nitrogen are then picked up by the growing plant system and if the plants are thus removed by croppy those nutrient components would be removed.

Simultaneously, the so-called organic contamination consist to a very large extent of carbonatious material, which is a residual which is not removed in the secondary process, and provides food for the organic growing system at the surface of the soil and the nitrogen being the main components of concern and the conversion is an end product of carbondioxide and water and nitrates in its simplest form.

It must be realized that nitrates, even the products of decomposition of any from general materials, can become a potential hazard to the ground water. However, fortunately, the so-called process of denitri-

fication takes place under anaerobic conditions below the soil surface itself. This results in the removal of nitrogen as a nitrogen gas, which then evolves into the environment. The removal of nitrogen, then, which is one component of a sewage, which can travel from sewage into the ground water, can be removed and is removed, in fact, by two processes,the denitrification and the other by the growth of plants that are on the surface of the soil. It is the nitrate component which is of major concern in the monitoring process.

Q Now, as respects the seepage of the spray system and the ground water supply, what if anything does that seepage do to that?

A This water is then, after the seepage process in the water, is then adequately going into the ground water supply and, therefore, recharges it. It is a recharge process. The water is thus renewed.

Q With more particular reference to the water supply as a general proposition in this area, of Chester Township and, also, with regard generally to the Caputo tract, what is the source of potable water for single family lots in areas such as this?

A The single family lot would probably have individual water supplies and their own wells.

Q What problems if any exist as to the contamination of wells and water supply for a single family homes where there are septic systems?

A There is always the danger and concern of cross-connections between the septic tanks and the well, both being on the same property and lined in close proximity to each other.

Q What monitoring, if any, is had by any governmental or other authorities as to the impurities of the individual water supply systems?

A None.

Q Now, how would a multi-family system such as the one on the Caputo tract be served with water, potable water?

A Obviously, individual wells would be impractical. Therefore, there must be a central water system, the design of which would have to be approved by the New Jersey Department of Environmental Protection and the water would have to be treated and chlorinated in order to render it safe to drink. The water would be distributed to the householders under pressure with redundant units to insure continuing service.

Q Which is the authority which has the monitoring control over such a system?

A The public water supply must submit quarterly

reports to the Bureau of Potable Waters of the Division of Water Resources, indicating that the water is meeting specifications and that laboratories are monitored and that the laboratories are approved by the U.S.E.A., or the New Jersey Department of Environmental Protection to insure the validity of the testing results.

Q Do you know if the water supply systems for large projects such as multi-family projects would have just enough units at any one time to supply all of the persons that might use it, or what?

MR. FERGUSON: Objection. I am not sure I understood it.

THE WITNESS: Would you mind repeating it?

THE COURT: Never mind.

BY MR. LINDEMAN:

Q So far as governmental regulations are concerned, would a system, a potable water supply system for a multi-family complex such as that on the Caputo tract, have just the number of units furnishing water that would be required at any one time to serve all of the residents or would it be lesser or more units?

A Well, the standard practice in engineering is to have a factor of safety and the New Jersey requirements are that there be redundant units and piping units

particularly so if one would fail the other would still be operation.

Q With respect to the surface runoff, what if any is the adverse impact of surface runoff in an environmental sensitive area such as the one we are talking about particularly as to the impact on streams that run through Chester Township? Just tell us in a general proposition what that is?

A The runoff whether it is from that low land woodland agricultural land or community land, will contain some contamination which will have adverse effects on the quality of the water.

Q And what is one of the most flagrant causes of contamination in a runoff?

A Well, sediments resulting in erosion will probably be one of the major problems as far as the Peapack Brook is concerned.

Q Can you tell us generally how sediment resulting from erosion is controlled, first, in a single family and in the construction of single family houses?

A What controls if anything are available?

Q I think if you go to Page 7 of your report.

A Right. The procedures for erosion are required by state law, New Jersey Chapter 25, Public Law 1975

and, also, by the Chester Township ordinance.

Q Is that for multi-family, or for single family dwellings, or both?

A This applies to all developments with the exception of your single family construction.

Q So that if the property such as the Caputo, or any other tracts in Chester Township, were developed with roads to be built through the tract and drainage pipes to be installed, approval would first have to be obtained from whatever bureau of sediment control may exist, is that correct?

A Correct.

Q But then if separate units are sold off, and separate parcels of land are sold off, undeveloped that is tc say for construction, either of a house or septic system or whatever would be built on the property yet to be done, what authority is there for controlling sediments from erosion?

MR. FERGUSON: I object at this point and ask that the question not be permitted.

What authority there is available is too vague and not particularly within this expert's realm of expertise.

If he can identify what is common practice either in the engineering field, or if he can

identify a specific regulation of a municipal body, I have no objection, but just a vague question; are there controls available, I object.

Number two, I am not sure that there are not subdivision controls which would go into effect. A zoning ordinance does not require complicated erosion controls for building one house on one lot, but if you are building a development on four houses, I think it does.

MR. LINDEMAN: If your Honor please, I think the thrust of counsel's objection is something which more properly comes out in cross-examination, but I will say that what I am driving at, which I think is fairly clear although the question is not very well stated or framed, is that with respect to the construction of an individual home there is no approval required. Well, the question goes to whether or not there is approvals required from any governmental bodies in terms of sediment from erosion, controls from erosion sediment and pollution from erosion, whereas in multi-family construction zones, something different may apply.

Now, I concede that if there is to be

multiple construction of a development by one builder that other considerations may apply and that approval of the sediment control division or whatever it may be called may very well be required.

THE COURT: Why don't you rephrase the question and let us see? It was a broad question. It was a very broad question.

MR. LINDEMAN: I will try again.

Q Do you know, Doctor, if there is any governmental authority in which a single lot owner must apply for approval in terms of sediment control when he commences construction of his home?

A I am not aware of any such requirement.

Q And is there any requirement for obtaining approval of a governmental body respecting sediment control with a complex such as multi-family dwellings or any other large construction other than single family dwelling?

A Such control is given in that reference which I mentioned a few moments ago.

Q Now, with respect to runoff of sediment into the environment, from which kind of construction is there more damage likely to occur, is it in multi-family or single family dwellings, and state your reasons,

please.

A You mean a single family dwelling?

MR. LINDEMAN: Yes.

THE WITNESS: If we refer back to our conversation and the testimony just given in the previous moments, the answer is that under multiple family dwellings that erosion control requirements are established. For the construction of a single family home on a lot by the owner, erosion control measures are not required for construction of that home.

Q Now, what would be required of a multi-family development for control erosion such as you understand it? I am speaking now of the requirements of governmental bodies?

A Those requirements are specified in detail in the law just cited and the details of which are given that is, the engineering details of the procedures are given in reference to my report.

Excuse me. That is incorrect. It is reference 6.

Q And what are some of those items of control that the government may impose?

A Proper ditch design, covering of turned-up land and planting of sod, the construction of temporary

retention basins, temporary until the construction is completed and the landscaping is complete.

The entire document is multi-paged and I have a copy with me if anybody would be interested.

Q Are those requirements imposed upon the isolated single family constructor?

A They are not.

Q What is the function, if any, of a lake such as the one that is shown on P-2 in evidence in respect to sediment erosion control?

A The lake would serve as a sediment trap.

Q Would you describe what you mean by that please?

A Yes. Storm water would run off.

MR. FERGUSON: I object because I think this testimony is going into what P-2 is going to do. I think it says state plan approval.

MR. LINDEMAN: Your Honor, it really is not. I can understand that the distinction may appear to be fine, but I think it is not.

The testimony from six or seven of the defendant witnesses was that when you build, that you have got a problem of runoff control and runoff pollution and that was all very general, and there was no testimony that I

recall as to how it happens or why or how, if at all, it can be controlled. Now, when this witness will testify as to the function of a lake, he will show how this multi-family construction, such as may be contemplated here, something can be done which would, perhaps, be very different from that which exists when you build an isolated single family home.

The witness is not going to testify about where this lake is going to be, or whether it is going to be as big as Lake Michigan or Lake Hopatcong, but simply what the effects of it is or could be and that relates to the effect or impact, if any, of runoff. That is in the record already and I think that plaintiff is entitled to show that that kind of thing will be controlled, perhaps, better than by single family dwellings than the way that the Township has identified it.

THE COURT: As you have been discussing it, I am thinking: When do you build a lake? Do you build a lake during construction, or before construction, or if it is single family dwelling, is it going to help control the sedimentation if it is a subdivision type of

thing and it is a condition of the subdivision that is required?

I am a little concerned about the direction your proofs are going because you are talking about isolated single lot construction and, yet, I know there is a subdivision ordinance here that you only get one or two minors, I think, and then you have got to go to the majors and once you go to the majors you have got to meet all the requirements of the majors and, then, that lake could be built or be required to be built before the individual lots could be constructed them.

I assume that you are discussing here building developments and, then, selling off lots one at a time to property owners so that they can build their houses, aren't you?

MR. LINDEMAN: That is what would have to be done if this were--

THE COURT: Now, why couldn't the Township say: Okay, you have got two minors, and you cannot get another minor? You are going to have to get a major and come in for a major and say: Okay, for the condition to control sediment you are going to have to do the following? You

are taking it from a lot by lot proposition. So, I don't know whether this sediment control is going to take place. Your theoretical questions, I assume, were directed to him on a theoretical lake which is going to be built before construction in multi-family dwellings setting, am I right?

MR. LINDEMAN: Right.

THE COURT: But not before construction in a single family?

MR. LINDEMAN: Not ever, probably.

THE COURT: Okay, but you are overlooking what I read the zoning or subdivision ordinance to say. You are overlooking it.

MR. LINDEMAN: I think that is not what is likely to happen in Mr. Bellush's case. He built a road and was subdividing it and, then, he is going to sell off individual parcels and he is finished now and those people will either have to have site plan approval or--

THE COURT: You mean in Mendham?

MR. LINDEMAN: Not in Mendham, but he is the one who built in Mendham. He has this development in Chester Township and, apparently, his proofs are about to be approved, and Mr.

Fox, the Township Engineer, says it is an excellent development, but that is the kind of a thing where he has already gone through his major subdivision and he has got the lots all set up and he is going to sell them off individually and then, presumably, the owners of the individual lots will build their houses. That is what I am thinking about. I am thinking that if the Caputo tract, or a tract such as the Caputo tract were to remain as they are of two acre and five acre zoned areas, then, the alternative available would be to build a road that would service the whole series of parcels. They would be subdivided and that would be the subject of an application to the Planning Board and, presumably, would be approved and, then, the property owners would sell off the individual lots and then there would be no further ability on the part of the municipality or any other governmental agency, as we now understand the law, to control the sediment from erosion. That is what I am talking about.

THE COURT: Well, all I am doing is suggesting to you that I can see a hole in your theoretical presentation in that once you go to

a major subdivision, the developer can be required when he sells it off in single lots, or builds for himself, he can be required to construct this sedimentation control lake and what you have got here is a situation where you have a brook running through the property. You will recall that Mr. Bellush talked about not having drainage constructed throughout the development and having it all funneled down through one pipe and concentrating it in some one area that he talked about, breaking down the drainage and having, I think he called them dry well type areas where the water runs off a specific area and is adsorbed back into the soil.

So, he talked about, I guess, some kind of a zone sedimentation control. I do not know what the concept was there. He did not get into it, but I am just suggesting that when you ask this question you are leaving a hole for me. So, if you are talking specifically about the site, the argument relates to your proposal for site plan approval in part.

MR. LINDEMAN: No. I think what the Court may be concerned about my doing is in that

I am trying to compare multi-family as opposed to single family development and to show how single family development is really terrible or bad, as compared to what the Caputos want. It is not precisely that.

What it is that we are trying to show is that what we would propose, or what functions and the kinds of things that we propose, is something that would be safe to the environment and that would counteract the testimony of the defendants, which showed that when you have people living in a place you have got runoff and you have got sediment from erosion problems. We had that lady from the Upper Raritan Water Shed area talking about the sediment that she noticed when the shopping center was built in Chester Borough; and Mr. Lloyd who testified at some length, as I recall it, about the existence of sediment in the Peapack Brook on the second or third time that he examined it and his conclusions that that increase in sediment was as a result of construction and the influx of some people into the area between the time that he first examined it and when he later examined it.

Well, now what we are going to deduce from the testimony is that it will show that it can be avoided by a lake, which is what our people propose.

Now, if an individual property owner or if that development would have individual lots and would also be required to have a lake, God bless them, that is fine. I am not saying that it should not be done, but I am saying that it can be protected in the way we are proposing it. It is not as terrible as Mr. Lloyd would have made you believe.

THE COURT: For the purpose of rebuttal, it is proper. There is no question about it.

MR. FERGUSON: I only comment that I do not think our testimony was ever as categorical or as all that bad. The Court has articulated it very well as to the problem that I have with this kind of testimony with assumptions being made, and I do not think that I will take any more time on it.

THE COURT: I remember what the testimony was, or at least I will put it this way that I can go back and refresh my recollection when I review it, but I do remember he acknowledged it

and I think there is a little over-dramatization.

MR. LINDEMAN: There is. I am sorry for the over-dramatization.

THE COURT: But for the purposes of rebuttal, it is allowable.

BY MR. LINDEMAN:

Q Getting back to this, then, what is the function if any of the lake in respect to sediment from erosion and control of this problem?

A The lake serves as a sediment trap and the storm water runoff runs into the lake in approximately 80 per cent of the development area. The sediment would settle in the lake and the water coming out would be free of sediment.

Let me clarify that. It is impossible to get all of the sediment out of the water.

Q In single family construction, assuming that single family homes were built without a lake, what would happen with the sediment?

A Well, the sediment would go into Peapack Brook.

Q What other pollutants are found in surface water runoff areas such as this?

A The main concern are those which are categorized as organic pollutants, heavy metals and nutrients.

Q And how do these pollutants find their

way into the ground water and stream water systems?

A Well, the vast majority of pollutants with the exception of ammonia are attached to particular matter and adequately demonstrated numerous times and the particular matter, that is, the sediment would be removed in the lake or the detention pond and, therefore, these pollutants would not enter into the Peapack Brook, but would be retained in the detention pond and/or lake.

Q Do you have any view or any opinion as to whether the runoff from a multi-family housing development where there would be a lake such as that in P-2 in evidence would be greater than that from single family units either with or without a lake?

MR. FERGUSON: Object until it is specified when and where we are looking at the runoff, and whether we are looking at the runoff before it gets to the lake, or are we incorporating in that question the function of the lake as a sediment detention mechanism, and a mechanism which traps organic pollutants and therefore measuring its runoff in the downstream?

MR. LINDEMAN: I mean the runoff in the stream, the downstream and the ultimate effects of the runoff.

MR. FERGUSON: I object to the form of the question in that we are not asking about the runoff. We are asking about the total resulting pollutants from runoff having been captured in storm water systems and dropped into the lake and then the things happening and then going down stream.

MR. LINDEMAN: That is what I think I did say.

THE COURT: Why don't you rephrase the question? You are tying it into multi-family developments with a detention pond, as opposed to a single family development with or without a detention pond, and the effective runoff from that development, whichever it is, into the stream ultimately?

MR. LINDEMAN: Actually, I think the question is--well, no, it seems to me that has been answered.

Q What effect, then, would the development of multi-family units on property such as the Caputo tract have? What effect would there be of pollutants in the runoff upon a stream such as the Peapack Brook downstream of the lake?

A The majority of the pollutants would be removed

in the lake or retention pond.

Q Now, as to the extent of the pollution either before the runoff or into the sub-surface system or sewage system, whatever sewage system is developed, have you studied the question of the extent of any such pollution from individual dwellings as opposed to townhouses that may be built together and concentrated in a smaller area?

A Are you referring to surface runoff?

Q Both surface runoff and any pollution from whatever other sources arise out of the existence of people in construction on property.

A You used the word, sewage? Did you mean sanitary sewage?

Q No. I mean pollutants generally? I mean polluting of the atmosphere, rather than the environment?

A I am afraid I do not understand your question. Would you rephrase it?

Q Let me state it again:

Have you studied the effects of pollution in the environment based upon the number of dwelling units that may be constructed in a sensitive area such as that of Chester Township?

A I have not collected data. However, I reviewed

the reports of others who have collected data, attempting to compare the magnitude or amounts of pollutants from multi-family and from single family type developments.

Q Now, have you formed any opinion as to whether or not the pollution per unit in multi-family development is greater per unit than it is where there is a single family development?

A There is no evidence that I can agree with that supports the contentions that there is more pollution per unit from multi-family developments than there is from single family developments.

Q You have studied, have you not, General Whipple's report?

A I have.

Q Where he makes a statement to that effect?

A I have.

Q Do you know the basis upon which General Whipple arrives at that conclusion?

A I do.

Q What is it? Just tell us first what it is without describing it?

A His conclusion, or study?

Q Not the conclusion. Where does the conclusion come from? What documents or reports?

A That study came from data collected by a graduate student at Rutgers, a graduate student in our department, that is, the Department of Environmental Commission. He was working on a project supported by a research grant to the Water Research Institute and Water Resources. He worked with General Whipple on that data collection.

Q Have you had occasion to see that report?

A I have.

Q Had you had any occasion to examine it with a student in some kind of any supervisory capacity?

A Yes. The student has three members on the committee. General Whipple is one. The chairman of the committee is a Dr. Yu, and myself.

Q Would you tell us what the report is?

A It is a draft and it is indicated as Reference Number 17.

MR. FERGUSON: I thought we were referring to D-37?

THE COURT: He does not know what D-37 is.

MR. FERGUSON: That is General Whipple with Joseph Hunter and Shaw Yu and is called: Runoff Pollution From Multi-Family Housing.

MR. LINDEMAN: The testimony in that report of General Whipple and his conclusions are that the runoff of pollution is greater per

unit where there is multi-family dwelling as opposed to single family dwelling. That is the report that the witness now testifies to.

MR. FERGUSON: I don't know if it is or not.

MR. LINDEMAN: He says that it is.

THE COURT: I think I recall General Whipple referring to the study made by his students that he relied upon. He did not condust the study himself and I cannot without going back to my notes recall whether it was done under his supervision, but I don't believe it was. I think he said it was done in conjunction with his authority, let us say, at Rutgers, and this this study was conducted by the students themselves under the supervision of one of them. I don't remember his name.

MR. LINDEMAN: That is my recollection, too. My recollection is that the student did the sampling.

MR. FERGUSON: And it was done under General Whipple's supervision and the design of the study was General Whipple's. That was my recollection.

THE WITNESS: That is correct.

BY MR. LINDEMAN:

Q Now, tell us please, Dr. Granstrom, what the report was and describe it as best you can so that we may understand it and from which that conclusion of General Whipple was drawn.

MR. FERGUSON: Your HOnor, if we are going to have testimony about a report, I would like it marked for identification, if the witness has it.

MR. LINDEMAN: We have to have it.

MR. FERGUSON: Can you mark it?

THE WITNESS: I have it. It is a personal copy of the master's thesis draft, which should be returned to the student master with my comments. This is one of my reports.

MR. FERGUSON: Well, if it is going to come up like this and be the subject of testimony--

THE COURT: We would be responsible for making a copy of it. Is there any problem with that?

THE WITNESS: No, sir.

THE COURT: Okay. You will be responsible Mr. Lindeman, to make a copy.

THE WITNESS: May I interrupt, please? With the student's permission I will make a copy.

It is in draft form. He has not submitted it in final form in which case, obviously, the copy is available to the public. So, I am afraid that the draft form would have to be with the student's permission.

THE COURT: If he was going to testify, he would have to have a copy made available.

MR. LINDEMAN: I will have a copy made available, if the student permits it, but otherwise--

MR. FERGUSON: Here we have a witness for a defendant who is testifying to something and I would like to have this report.

THE COURT: But this is another report. Whipple made his own report, based upon studies that were conducted, as I understand it.

THE WITNESS: Correct. This is the report.

MR. LINDEMAN: This is the report upon which it was based.

MR. FERGUSON: That is not my recollection.

THE COURT: I really cannot say at this point.

MR. FERGUSON: I don't know where Mr. Lindeman is going. If we are going to have

testimony from this witness about a piece of paper stapled together, I would just like it marked.

THE COURT: Let him testify to it so that he does not have to come back; and if he cannot get permission of the student, then, we will have to exclude it. I do not see any other recourse. I do not recoolect, very candidly, what General Whipple said about the thesis prepared by the student. I remember that the students collected the data and collate the data. That is all I can recall without going back to my notes.

MR. FERGUSON: With all due respect, how can I cross-examine him?

MR. LINDEMAN: I certainly think that it would not be any problem about cross-examination from the document itself.

THE COURT: If there is cross-examination, we are going to be using it.

MR. LINDEMAN: I would ask the witness this question: Would there be objection to using that document in cross-examination in a case like this? Do you think there would be, Doctor? Is that something which would violate

the rights of a student, do you believe?

THE WITNESS: If the Court and the counselors can understand, please, that this young man is caught somewhat in the middle between two advisors.

THE COURT: I can see that.

MR. LINDEMAN: Yes, I do, too.

THE WITNESS: And I have the highest regard for the young man and I would hate by any stretch of the imagination to put the successful completion of his master degree in jeopardy by submitting that data which he has collected and which not yet been published as a thesis.

However, if I could make one additional statement? I have written in the report, which is submitted in evidence, that some of the procedures used in the conclusions drawn, that is, that multiple family dwellings cause more pollution per unit than single family units, I have stated that I do not agree with that conclusion because it is based on insufficient evidence. I am prepared to discuss this at length, if need be. However, I do not see at the moment that I can take this gentlemen's, or

this young man's thesis and submit it without his permission.

Now, what I have stated is a rather strong statement and I am willing and perfectly capable of defending my statement. However, I repeat that I do not wish to jeopardize this young man's completion of his degree.

THE COURT: I do not think he should be made to, either.

MR. LINDEMAN: I agree with that, your Honor.

THE COURT: That puts us in a rather awkward position. I see myself as balancing Dr. Granstrom against General Whipple, one having one opinion about this subject and the other, perhaps Dr. Granstrom, will testify at greater length than General Whipple did on the subject, but this is what makes experts. They either draw different conclusions from factual data, or they say there is disparity as to the weight that they were willing to put on what it says there, but still I am not going to put him in a position of having to do something that he does not feel he can do.

MR. LINDEMAN: I would not press that,

either, of course not, only because he is my witness.

THE COURT: Is there any way we can move around this and come back to it after?

MR. LINDEMAN: Let me try it this way, your Honor.

The first witness has already stated that he believes, as he has shown in his report, that the conclusion is not a correct one in General Whipple's report, as I recall, he annexed to that report--

THE WITNESS: If you please, sir, could I get my copy?

THE COURT: Surely.

THE WITNESS: It is the same copy. I have it.

THE COURT: If it is the same document, you have a document to cross-examine him on.

MR. FERGUSON: I do not know what the other report is.

THE COURT: Off the record.

(After a short off-the-record discussion, the following occurred:)

BY MR. LINDEMAN:

Q Doctor, you have examined, have you not,

the report of General Whipple which has been admitted into evidence in this case as D-37?

A I have.

Q Now, does that report contain some facts and figures upon which conclusions appear to be based that pollution per unit from multi-family dwellings are greater than that from single family dwelling construction?

A May I correct you, Mr. Lindeman? He says particularly with respect to BOD, and phosphorus.

Q Yes, with respect to the BOD and phosphorus, yes. With respect to those elements as pollutant elements. Now, can you tell us this:

Have you formed an opinion as to the facts and figures from which the conclusion is drawn insofar as D-37 is concerned?

A I have.

Q Now, what is that opinion as to the conclusion and its validity, if you will?

A I would say that the evidence submitted in this D-37 is inadequate to draw the conclusions that were drawn.

Q Would you tell us why?

A Just from what is contained in D-37. On Page 3 of the report there are listed four different storms

which were surveyed. I believe the report indicates the procedure by which the survey was made, which is that the data collector went down into the storm sewer and measured the depth of the flow in the sewer and from calibration estimated the discharge in the sewer as related to the depth of the flow of the sewer. He then sampled periodically and, then, proportioned the mixture of samples in accordance with the magnitude of the discharge at the time of the sampling. Composite sampling was then analyzed in the laboratory and the results are published on the table on Page 3 of this particular document.

Q Now, what opinion, if any, do you have as to the method that the students employed in this?

MR. FERGUSON: Wait a minute. Can I see Page 3?

That is not the same document. I am sorry, your Honor. That is March 1977 and this is November of 1977 and we are in a different ball game.

THE COURT: Let him see D-37.

Please show the witness D-37.

MR. FERGUSON: You were comparing Page 3 with Table 2 and it wasn't in it. Let the record show the witness had indicated that he

had the same document as D-37 for identification. I am afraid that was in error. I am sure it was.

THE WITNESS: That was an error. I am sorry.

MR. FERGUSON: I stand to be corrected, but I believe what this witness is testifying to is from a preliminary study done by General Whipple with respect to the Caputo land. I could be wrong, or this could be a preliminary finding.

THE WITNESS: There is some difference.

MR. FERGUSON: Is what you are looking at a preliminary report?

THE WITNESS: Yes.

BY MR. LINDEMAN:

Q Does the difference relate to your testimony?

A The difference is not significant.

MR. FERGUSON: Then, we should have testimony from the one used at the trial.

THE COURT: Could you do this, Doctor? Could you take what we have called D-37 and look at it and then from the reference and what you have talked about as the table on

Page 3 could you tell us where that table is located in D-37?

THE WITNESS: The data on Table 2 in my copy is not reproduced as a table in this document, which is D-37. However, the information is available in the narrative form rather than in the tabular form.

THE COURT: Is the table necessary for your testimony?

THE WITNESS: The table is not necessary for the testimony which I intend to give at this instance.

BY MR. LINDEMAN:

Q Can you testify, therefore, from D-37 as such rather than from that?

A I can.

MR. LINDEMAN: I will give him a moment to look at D-37, just to make the other comparisons and then we can proceed.

THE COURT: All right.

THE WITNESS: All right. To continue with my discussion, if I may, the method of estimating the runoff from measurements of the depth in the storm sewer is based upon the assumption that the depth and discharge are

related in the log-log plot.

The geometry of the circle, the segment of a circle and the discharge relationship, as described by a standardized hydraulic formulas do not permit the assumption that the discharge and depth are linearly related on a log-log rhythm plot.

The further information is hearsay, if that is permissible.

MR. LINDEMAN: Well, what were you going to say?

THE WITNESS: The young gentleman complained to me during one of these that the water was so deep and coming so fast that he really did not measure the depth because it was a 42-inch sewer and water was running down and he could not get in there to measure it and he merely sampled it hanging from the inside of the manhole.

The second point I would like to make, if I could, is that the use of the equation on Page 3 of the document in evidence, is a misstatement of what is termed the core of the storm model equation.

Q You say that the equation is incorrectly

stated?

A The equation is incorrectly used. The equation is incorrectly used in that the infiltration estimate in that equation is based on an annual value in this document, whereas in fact the equation refers when used correctly to an infiltration in inches per hour, and not in inches per year.

Referring again to that same use of the equation, or use of the same equation, one must draw the assumption that the entire water discharge from the twin rivers project occurred only during a storm period.

Water does infiltrate into the soil and reappears in the rivers at a later time as the ground water recharges and the annual average, based on the discharge in the Millstone River of which this is a tributary, is approximately 21 inches.

By the use of this equation shown on Page 3, one would have to assume that the storm discharge was greater than 21 inches, which in fact is not likely to be the case.

The third point I would like to make is that the total amount of runoff measured in the sewer by the method indicated was less than two inches in the six or seven different sampling periods. By the use of the equation on Table 23, the data obtained from

the discharge of two inches of runoff was extrapolated to approximately 22 inches of runoff, which is an elevenfold extrapolation of data. A traffic engineer would not attempt to design a traffic system based upon five simple observations during the course of the year. You would make many observations in a period of time.

Putting these several components of my conclusions together, and I will try to repeat them:

One, the data is of questionable validity. It is inadequate in amount. The computation procedures are in error and the extrapolation is in my opinion far in excess of anything permitted from which conclusions could be drawn, or conclusions of this type could be drawn.

Therefore, I repeat, as indicated in my report, that I believe that the information or conclusions drawn in the document under discussion are not justified.

Q Doctor, getting back to the function of the lake as a retention or detention factor, how much of the pollutants could be removed or would be removed if there was a retention pond such as shown on the Caputo drawing of the surface water runoff?

MR. FERGUSON: Objection.

THE COURT: He told us that.

MR. LINDEMAN: Yes, he did. I beg your pardon.

THE COURT: He gave us the percentage.

MR. LINDEMAN: You are right, your Honor. I am going back. I am sorry.

THE COURT: The general effect is what he was talking about.

MR. FERGUSON: The question was directed at P-2.

THE COURT: All right.

MR. FERGUSON: And there is a big difference.

THE COURT: He has told us enough with respect to that, I think, in the framework of rebuttal.

BY MR. LINDEMAN:

Q As to the function of a lake in a multi-family dwelling such as might take place in the Township of Chester, what is the detention time in a lake which let us say would be 16 acres holding 345 acres holding this amount of feet of water when full?

A The average detention time by my estimate is 108 days.

Q By the way, what do you mean by detention?

A That is the time that it would take to fill up the lake at average flow conditions. This assumes no seepage and no evaporation.

Q What is meant by eutrophic ation?

A Fertilization, and in this case of the lake.

Q What is the eutrophication effect in a lake such as the one I have just referred to?

A They would result in algae.

Q It would result in algae?

A Yes.

Q Now, you will note that Mr. Lloyd in his report showed that the phosphorus concentrations in Peapack Brook at the Caputo tract and the estimated the average brook discharge in the area of the Caputo tract and I think he also stated that the additional phosphorus would be added to the lake by the storm water runoff from the tract.

A Right.

Q Now, I think your words are that the geometry of the lake, that is, assuming it is a 16-acre lake and five feet of water that you can estimate the degree of mesotrophics?

A Yes.

Q In such a body of water?

A Yes.

Q Now, first, before the next question: Could you define the word mesotrophics?

A That is a gray area between the other two streams which would be eutrophic and oligotrophic.

Q All right. That is close enough.

Now, we have got mesotrophic and eutrophic and oligotrophic.

Mesotrophic is what?

A It is a gray area between the other two, between the two streams.

Q So, eutrophic is what?

A The fertilized algae growing and probably an oligotrophic. The lake probably would not have algae growing.

Q What would that lake be using in average values--

MR. FERGUSON: Objection. This is what this lake is going to do to this stream. Now, I have three or four witnesses who can testify what the site plan and lake are going to do to the stream. Indeed, General Whipple calculates using other methods, phosphorus and BOD and they were not from the storm water runoff going into the lake. He is opening up a whole new thing.

MR. LINDEMAN: I think it is difficult to fix upon what we go beyond and what we stay out of.

THE COURT: That is what I get paid for. Whether I am right or wrong, that is what I get paid for and I think that what you are doing is going beyond it.

MR. LINDEMAN: If I may just express my concern, I understand the Court's view, but we had testimony from a number of witnesses and I will not go into the detail of it that when you have construction that that lake and somehow the stream gets polluted when you have a lake which stops the flow of water and it becomes more polluted than it would be if there were no such lake at all.

What I am trying to show here is what the effect of the existence of a lake would be and how a lake can be treated and whether or not that which would flow in the lake would be a bad thing or would adversely affect it.

THE COURT: If you want to talk theoretically, fine, but if you want to talk in specifics about this lake, I think you are getting into difficulty.

BY MR. LINDEMAN:

Q First, assuming that the lake would eutrophicate, at what time of the year is that likely to happen?

A It would be in the summertime in any lake, not this particular lake.

Q By eutrophicate, we mean that the algae and similar growth would appear and develop?

A That's correct.

Q In a body of water?

A Yes.

Q Is there any method by which such eutrophication can be controlled?

A There are algicides which could be put into the water.

Q What would be the effect of the algicides?

A To kill the algae.

Q What effect if any would the algicides have on the potability of the water?

A A guide can be used in the potable water supply.

Q Have you formed any opinion as to the relative advantages or disadvantages in the development of multi-family construction as opposed to single family construction in the respect of their impact on

the environment?

A I have.

Q What is that opinion?

MR. FERGUSON: Whose conclusions? I object to the question unless the witness states what his assumptions are and what he is talking about as to the number of units, or whatever. That question is as broad as saying: Is it good or bad, and I am totally at a loss as to what I can object to on that question.

MR. LINDEMAN: I had the same problem with Mr. Lloyd. That is really what got me so distressed.

He says that if you build more houses you have got problems. I had to meet it somehow. I realize the question is a broad one.

THE COURT: Based upon his testimony today and based upon what he has already said and nothing beyond that. I will allow it.

BY MR. LINDEMAN:

Q Do you remember the question now?

A Yes.

THE COURT: What is your conclusion?

THE WITNESS: Multi-family developments properly constructed and properly maintained

with the type of facilities indicated in this testimony, that is, a good sewage treatment facility, a good water treatment facility, sediment traps and good erosion controls, can result in no greater impact on the water body than a single family dwelling plan, as indicated under the conditions which we have discussed, that is, individual septic tanks and individual wells and a lesser control of drainage systems and lesser control of erosion problems.

In other words, it is primarily a controlled design engineering management maintenance problem and it does not say that this is essentially the requirement in order to meet the environmental controls required to meet the conclusions which I have drawn.

MR. LINDEMAN: I have no further questions.

THE COURT: It is 12:30. So, we will break for lunch and be back at 1:30.

You may step down, Doctor.

(After a luncheon recess, the following occurred:)

THE COURT: Cross-examination.

CROSS-EXAMINATION BY MR. FERGUSON:

Q Professor, I noted in your qualifications that you had written a book with Mr. Shut?

A Yes.

Q Would you tell us who Mr. Shut is?

A He is an associate professor of Civil and Environmental Engineering in that department of Rutgers University. He is a colleague of mine.

Q And with him you published publication number 60 in your curriculum vitae?

A Yes.

Q And Mr. Shut was also an author?

A Correct.

Q And you also published number 11 on your curriculum with Professor Yu, along with two other gentlemen?

A Yes.

Q And is Dr. Yu the same Dr. Yu who was a co-author along with General Whipple and Professor Hunter of the Exhibit D-37 for identification?

A It is.

Q Did you ask Dr. Yu about D-37 at all?

A I have not.

Q And did you ask Dr. Joseph Hunter about D-37?

A I have not.

Q And do you know Dr. Hunter?

A Very well.

Q And where is he?

A He is in the department of environmental science, Rutgers University.

Q Are they members of the Water Resources Institute?

A Dr. Hunter is, as am I, a member of the Water Resources Research Council, which is a policy-making board for the Water Research Institute.

Q Have you spoken with General Whipple about D-37 and his conclusions?

A I have not.

Q Would your criticism of the methodology extend to all three authors together insofar as they signed it?

A It would not.

Q Why not?

A Dr. Hunter merely performed the laboratory analyses of the samples that were given to him. Dr. Yu is on leave this year. He is at the University of Virginia in Charlottesville and I have not had a chance to talk to him.

Q How do you know that Dr. Yu did not

contribute to the methodology of this paper?

MR. LINDEMAN: I object. I do not think there is any testimony that he knows he did contribute to it.

BY MR. FERGUSON:

Q Do you know either way that he did or did not?

A Repeat the question would you, please?

Q Do you know whether Dr. Yu contributed anything to this paper at all?

A I do not know.

Q How do you know what Dr. Hunter did?

A Dr. Hunter told me.

Q So, you have spoken with Dr. Hunter?

A I have.

Q Did you ask him about the conclusions of the paper?

A I did not.

Q And what was the substance of your conversation?

A What was your participation? He said: I performed laboratory analysis.

Q It did not extend beyond that?

A No.

Q Did you share with him your concerns

about the conclusions?

A I did not.

Q Professor Granstrom, are you aware of a distinction or if there is a distinction between structural and non-structural solutions to environmental engineering problems?

A I am.

Q Is that a commonly accepted definition or a commonly accepted term in your field?

A It is.

Q Would you tell us your definition of structural and non-structural?

A Structural would be any physical device, such as a wall tank, a sewer diversion chamber treatment facility, a culvert, and anything of this nature.

Q And what is non-structural?

A Non-structural would be such things as the control of slopes, land use plantings and landscaping.

Q Did you say control of slopes?

A Yes.

Q How is that non-structural? You tell me what you mean by the control of slopes.

A All right. Very simply, an excessively steep slope would result in more erosion than a flat surface.

Q So, a non-structural solution would be

to not build on the slope at all?

A That is correct, not on a steep slope.

If I can modify that response, the word steep also has to do with the type of soil cover. A steep slope on the side of a mountain would not be a problem. A steep slope with loose soil would be a problem.

Q So, the type of soil involved, as well as the degree of slope, is a component which you would examine in terms of the suitability for a particular piece of ground for a particular purpose?

A That is correct.

Q And as a general proposition would you agree or disagree with the statement that the less structural your solution is to a problem, the less damage to the environment ultimately caused?

A That is an extremely broad statement, Mr. Ferguson. I do not agree that I would accept that statement without considerable modification or explanation.

Q Professor, you stated that your report, which has been mared P-48 for identification, that as you were reviewing the zoning on the Caputo property you stated that probably environmental considerations, among other factors, influenced the zoning pattern?

A Yes.

Q Now, what environmental considerations did you have reference to in that sentence?

A I imagine it included therein the majority of the particular court hearings that have been going on for seven months as to the quality of the water in the Peapack River.

Q Did you have reference to any other factors such as, for instance, soil?

A Such as what?

Q Soils, or slopes?

A As we discussed briefly and recently, yes, soil is a consideration in the environment, yes, sir.

Q Are you of the opinion as an environmental engineer that the environmental characteristic of the land is an important component of the land use planning and zoning?

A Yes.

Q Are you familiar with the Soil Conservation Service Publication which has been marked as D-1 in this proceeding, giving the soil classifications and designations for the soil of Morris County?

MR. LINDEMAN: Objection. I hope that this isn't going to take a lot of time. I am afraid that that reference will not be sufficient for the witness to identify the effect. He may

or may not be familiar with it. D-1 cannot be enough for this witness.

MR. FERGUSON: I agree. It is entitled Morris County Soil Survey.

A Yes, sir.

Q As an environmental engineer do you have an opinion as to whether that kind of information is an appropriate use and is appropriately used in designing land use controls through a zoning ordinance?

MR. LINDEMAN: I object because I think it now goes beyond the scope of the direct and the witness is now being utilized as an expert on the defendant's case.

THE COURT: This is rebutted testimony. Normally, I would let you do this type of thing, but on rebuttal and his purpose was rebuttal, you are going a little beyond it, unless it is for credibility purposes. I think we are opening up a whole new area with him.

MR. FERGUSON: I will withdraw it. I may have to come back to it.

Q You testified on direct that all three of the R.M. zones in Chester Township were in the water shed area of the Raritan River?

A Correct.

Q Is there any piece of ground in Chester Township which is not in the water shed of the Raritan River?

A No.

Q So, your comments would go to the entire area of the Township?

A Yes, to the best of my knowledge.

Q Now, you testified about the septic tank field problems of single family housing.

How would the problems which you have described first come to the attention of anybody, that is, if the septic tank and tile field does not work, how does one know it does not work?

A The sewage appears on the ground.

Q In your experience is that a fairly recognizable phenomenon?

A It is.

Q As an environmental engineer do you have an opinion as to whether it is necessary to have a legislative or some kind of statutory control and inspection of septic tank systems for the purpose of seeing whether they do not work in a single family housing development?

A If I interpret your question correctly, you are asking should there be government controls for the

maintenance of septic tanks?

Q I will accept that amendment.

A Yes, sir. Anybody knows it is an intrusion on the individual rights and the cost to the government would be very, very high.

Q Would it also be true that they are not needed because failure of individual septic systems are readily apparent to a homeowner and, then, he will know he has to do something about it?

A If he so chooses.

Q Of course. He also has the freedom to ignore and let a bad condition continue.

A That is correct.

Q You testified that you had reviewed, I believe, the law or regulations about spray irrigation and monitoring thereof by the New Jersey Department of Environmental Protection?

A I did not testify to that.

Q Then, I misunderstood you. You did say that it would be required?

A I stated it is the policy and this came by hearsay from someone from the water pollution control section of the Department or Division of Water Resources and the Department of Environmental Protection.

Q Who was that?

A The name is Samuel Giallella.

Q And when did you talk to Mr. Giallella?

A Yesterday at lunchtime.

Q Did he inform you as to the status of the regulations for monitoring spray irrigation in New Jersey?

A It is a policy and requirement that the monitoring be done and is being done, yes.

Q Did he tell you the status of the regulations for monitoring of spray irrigation in New Jersey?

A He did not.

Q Did you ask him?

A No.

Q Are you aware that the regulations have been in draft form for upwards of 18 months?

A I am aware that they were in draft form.

Q Have you reviewed those regulations?

A I have not.

Q Have you had an opportunity to form an opinion as to whether those draft regulations are sufficient for any purposes whatsoever and, specifically, the appropriate monitoring devices or procedures to be used for a spray field?

MR. LINDEMAN: I object. If the witness

has not reviewed them, how can he form an opinion?

THE COURT: Sustained.

BY MR. FERGUSON:

Q Are you familiar with the regulations of the local board of health in Morris County and specifically, Chester Township?

A I am not.

Q Would you know or have you been told as to whether the local board of health has any power to regulate or monitor individual septic systems that do not function?

A I am not aware of such, no.

Q Have you investigated the local board of health as an agency that might have jurisdiction?

A I have not.

Q Now, when you were talking about spray irrigation, I believe you said--and you correct me if I am wrong--that phosphorus and nitrogen are the two main organic components of the effluent that is sprayed?

A I did not because phosphorus is not limited to organic contents. There is organic and inorganic phosphorus.

Similarly, there is organic and inorganic compounds of nitrogen.

Q I stand corrected. Was it your testimony that the phosphorus and nitrogen were removed from the effluent by the process of spraying and being adsorbed by the plants?

A That is correct.

Q Adsorbed?

A In general terms, yes.

Q Not being an expert in your field, that is the best I can do. What percentage gets adsorbed by plants and therefore removed?

A An estimate of about 95 per cent of phosphorus and a lesser percentage of the nitrogen. A lesser is the cropping that is taking the plant material from the ground. Nitrogen is going to come in the form of a nitrate and nitrate is a charged compound and it is not readily adsorbed on the surface of the soil and can migrate through the ground and enter into the ground water. The objective, of course, of a cropping is to remove the nitrogen in the form of a tree or whatever other plant is being taken from the soil. This is the objective of this.

Q Is cropping a necessary component of the care and maintenance of the spray field?

A Cropping would be a significant advantage in the removal of the nitrogen from the soil.

Q What about phosphorus?

A Not in the same extent.

Q But it would be important to some extent?

A It would be a help, yes.

Q What happens if you do not crop?

A If you do not crop, eventually the nitrogen is going to take one of two paths, either it is going to be reduced in the form of nitrogen gas, a process previously referred to as denitrification, or it is going to remain in nitrate form and pass into the water main.

Q Would it be correct to say that if you do not crop a spray field, that is, remove the vegetation which has adsorbed the nutrients and you let the vegetation fall, that there is a significant risk of the nutrients going back down to the ground into the water table?

A Well, I would say there is a good possibility, yes.

Q In making an evaluation of how likely that is to happen, what do you have to evaluate this? Specifically, do you have to evaluate the kind of soil and percolation rate and the effect of the soil on what happens to the water as it is going down?

A All of this, plus the original concentration of

the nitrogen compounds in the water, yes.

If I may add to that?

Q Yes.

A A great deal of research is going on currently, attempting to determine the fate of the nitrogen in exactly this type of matter and this type of problem. As a matter of fact, I am the thesis advisor to the young man who is doing this on a very large scale operation in one of the western counties in the State of New Jersey.

His review of the literature, which I am privy to as his advisor, indicates that the fate of the nitrogen compound is not well known and it is not clearly defined.

The possibility of nitrate seeping into the water is there, yes, we are in agreement. Now, the magnitude of it is going to depend upon the things which you listed, plus of course the amount that was in the sewer initially, but a great deal of unknown factors presently exist. Hopefully, in future years we will be able to give a more precise answer.

Q Would the degree of the slope of the spray field itself be a determinative factor?

A The degree of slope?

Q What degree and what influence would that

have on the spray field?

A I think it would be a negligable influence if the water was retained on the soil and did not run off in the form of sheet flow, I would say that the slope would not be of significance in this particular problem.

Q As long as the slope was not so severe that the water would run off?

A That is correct.

Q Spray assumes that the water is going to go down through the soil?

A That's correct.

Q What about the depth of the bedrock?

A The depth of the bedrock is an important consideration.

Q Do you know the parameters of the depth to bedrock for a successful spray field?

A One of the references in the report, Reference Number 3, suggests that a depth to bedrock 10 to 15 feet would create an ideal condition.

Q I take it that a greater depth to bedrock would not hurt, and that a lesser depth to bedrock might, depending upon all of the factors?

A That is correct.

Q What would be the appropriate strategy

to prevent the surface pollution or malfunctioning of septic systems and the contamination of a well that is the water supply and disposal system of an individual lot with a one family house on it?

A What is the best strategy?

Q In your opinion for seeing that the water supply for that dwelling unit does not get contaminated?

A First and foremost, put the well up the hill from the septic tank. Secondly, insure the septic tank is functioning properly, that is, that there is no surface breakout of the septic tank effluent.

Thirdly and certainly very important, would be the proper construction of the well.

Q Are you familiar with the geology in Chester Township area?

A Only to the extent of reading a report of Joseph Ward, which I do believe is one of the documents in this case.

Q Do you have an opinion as to the appropriateness of the lot size for use in Chester Township so as to prevent the pollution of your water supply from individual wells? You may not have? I do not know if you do or not?

A I would like to qualify my answer, if I may?

Q Yes.

A That is that the geology and soil would have to be known in some detail before such a conclusion could be made and this would be the soil in the immediate vicinity because it is not a homogeneous soil cover in this township. So, I couldn't answer the question without an individual evaluation of the site.

Q All right. Now, with respect to the surface water runoff and the sediment for the erosion problem, you testified a lot about a single lot owner and I just wish you would state for the record exactly what you meant by a single lot owner? Am I correct in stating that you were referring to one person who owned one lot and who wanted to build a house on that lot?

A That is correct.

Q And you referred to Chapter 251 of Public Law 1975, entitled "Soil Erosion and Sediment Control Act."

A I did.

Q And you said that did not apply to the single lot owner?

A That is my interpretation in reading the law, yes.

Q Are you referring to Section 36 of that Act?

A If you read it, I could respond. I do not remember what Section 36 is.

Q Okay. It is a definition of the project.

A I did not.

MR. FERGUSON: The Court can take judicial notice of that section, your Honor. I don't know that it does any good to ask this witness about it. All I have is a bill copy of it, but in your reading of the definition of the project that it says that if it is part of the proposed subdivision plan, special exception of zoning variance, planned unit developments or building permit applications involving two or more family units, then, you have to comply?

A Yes.

Q As a civil engineer do you know why a single family dwelling of one per lot and one owner is exempt under that statute?

MR. LINDEMAN: Object, your Honor, as irrelevant.

BY MR. FERGUSON:

Q Did you as a civil engineer have an

opinion as to whether you disagreed with the definition of that statute as exempting that kind of builder?

MR. LINDEMAN: I object to that question too, because it is irrelevant.

THE COURT: Why is it relevant?

MR. FERGUSON: Let me ask it this way:

Q Isn't it true that you really do not need the erosion controls for the building of one house on one lot because the disturbance of the ground is generally so small to be insignificant?

A Disturbance of the ground may be small but it may not be insignificant. May I add for a five acre lot with a house in the center, the driveway could be as long as 250 feet and as wide as ten feet and the house itself could occupy a space of 2,000 to 3,000 square feet with landscaping and, therefore, the total surface area exposed could be from half an acre to an acre and in which case a severe rain storm could cause significant erosion, if it occurred during the time that this land was open and before the landscaping took place and before the driveway was grounded.

Q I would like to suggest that the reason that the erosion control methods are not enforcible for a single family dwelling is that it would simply be too onerous a task for the government to get out

there every time a man wants to build a house and inspect what he is doing. He already has had several inspections by law. So, it is morelikely in my opinion a convenience for the government than it is a lack of need for erosion control purposes.

Q You said that a lake would act as a sediment control trap?

A I did.

Q Could you give us any estimate about how much sediment would be trapped by the lake and how much would not be trapped by the lake?

A The amount of sediment trapped by the lake would be well in excess of 95 per cent.

Q What happens to the sediment trapped by the lake?

A It settles to the bottom.

Q How long does it stay there?

A Until it is removed.

Q How often does it have to be removed?

A It depends upon the amount of sediment and the depth of the lake.

Q How is it removed?

A Dredging most likely.

Q Do you have to drain the lake to dredge it?

A No.

Q If you dredge the lake to remove the sediment, does that not stir the sediment up?

A It does.

Q If pollutants are attached in a particular form in the sediment, doesn't it stir the sediment and pollutants up to dredge it?

A Yes.

Q If you are dredging a lake with water going out of the lake over the spillway, aren't the sediments and the pollutants going to go once they are stirred up over this spillway and out into the stream?

A The answer is, yes. However, if I may add, it is not necessary to dredge during the time the water is going over the spillway. Dredging could very well be done in the time in which the water level is below that of the spillway and in which case the resedimentation of the disturbed material would take place.

Q At a period of low flow when the level of the lake is down?

A In the period of time in which there is no carryover from the spillway, or over the spillway of the dam.

Q Are you familiar with the term simulated

capacity of a stream?

A I am.

Q Would you tell us what that means to you?

A Simulative capacity of a stream would refer to almost any form of material that could be added to the stream. If you would be more specific and ask me what you are adding to the stream, then, I could attempt to respond on what the simulative capacity means.

In general terms it would be the ability of the stream to receive the material, whatever it is. It may be without a significant degradation of the water quality or of the bottom of that stream.

Q Do you have an opinion as to whether the construction of a 16-acre lake in a stream like the Peapack Brook would affect the capacity of the stream?

A Construction would be a greater disturbance, yes.

Q What about a permanent disturbance?

A It would not be a permanent disturbance in the downstream portion of the lake, except under the conditions to which you alluded, which is the dredging, which is an infrequent operation and that would only be disturbing when the water, the disturbed

water is being carried over.

Q Is the simulative capacity of a stream a natural method of water purifying itself?

A It is in general terms, yes.

Q And if one is interested in preserving the supplies of clean drinking water, is it not better to preserve the simulative capacity of a stream insofar as you can?

A Yes.

Q Now, during your testimony you sometimes said that the lake is a sediment trap and a detention pond was a sediment trap? I was not quite sure what you were referring to? Is the lake different than a detention pond, or is the lake a big detention pond?

A To respond to this question, I would have to ask am I permitted to refer to the proposed site plan? If so, I can define what I mean here. I spoke of them generally and used them interchangeably. I did not identify them specifically.

Q That was really my question. Did you use them interchangeably, the lake and the detention pond?

A The lake would serve as a detention pond, yes.

Q But a detention pond could be something quite different?

A A detention pond could be something different.

Q Aren't most detention ponds a dry piece of ground on which has been constructed some kind of retaining device to let the water seep back into the ground?

A There are two basic types of detentions. In fact, the word ought to be retention pond.

Q Retention?

A Retention, yes. The one is a so-called wet retention and the other is a dry retention.

Now, in the wet retention pond, the outlet device is above the bottom of the pond and there is a storage capacity or storm water discharge above the outlet device. The outlet device is sized such that the water is being retained temporarily in the basin. The water line below the outlet device would, in fact, thus seep into the ground, as it would from any other type of a lake.

Now, the dry detention pond is one in which the outlet device is controlled inside or designed inside to permit a controlled rate of release. That outlet device is located at the bottom of the retention structure, the dike and dam and, again, the water would seep out slowly over a period of several days in contrast with a large discharge in a short

period of time, which would result from high intensity rain storms.

Q With respect to the pollutants in the water in any lake retention system, you said that most pollutants attach themselves to particular matter?

A That is correct.

Q Is that true of a hydrocarbonates?

A Correct.

Q Is there any components of hydrocarbonates pollution which tends to remain in the solution?

A Yes.

Q And what components?

A Those are non-poloric. In other words, they do carry a charge.

Q What components of hydrocarbons tend to be non-poloric or non-IO.

A The smaller of the aromatics, or the benzine type, or the aromatic compound, the smaller and simpler ones are very possibly going to be dissolved to a limited extent in water. They are not soluble to water, but these hydrocarbons per se would tend to be slightly soluble in water.

I do not understand the question because the word hydrocarbon refers to a compound which are

hundreds of thousands and makes it difficult for me to describe it exactly. I do not know what you mean. I am not sure how to do it?

Q Let us take a crank case of oil, the dirty crank case oil from cars and trucks?

A The crank case of oil from cars, the main components then would be hydrocarbon. Most of those would be attached to particular matter. Crank case oil is not soluble in water.

Q Would any significant components of dirty crank case oil remain in the solution over a period of time?

A Generally, they are considered as insoluble and are not considered as soluble material. I am not prepared at this time to give the level of solubility of the organic compound.

Q Isn't it true that a major component of storm water runoff in multi-family housing is a hydrocarbon such as dirty crank case oil which drips enroute and then gets washed into the storm drainage system?

A Sir, your question again has a leading answer, isn't it true?

Q That is the way I phrased it.

A My answer is, no.

Q Why do you disagree with that? In what way do you disagree with the question?

A The words, isn't it true. That is most significant. There is probably going to be sediment washing off from any type of land using crank case oil. It will be there, yes. Where we have automobile parts, there will be crank case oil drippings on the ground.

The thing I am questioning here, sir, is the word, significant, and this is a subjective term from which I really cannot respond unless I had a fuller expression of your meaning.

Q That is a fair comment and I withdraw the word, significant.

Isn't it true, then, that some components of that crank case oil will remain suspended in the water?

A A vast majority would attach to particulate matter and if I must use the term, I will use the term of 90 to 95 per cent would be attached to particulates matter. I am not certain of those figures. I do have the reference with me, and if you would like I would look it up.

Q Does the particulate matter sink to the bottom of the pond?

A Yes.

Q Does it sink because it is heavy?

A It does.

Q If hydrocarbons attach themselves to it, does that change the specific gravity and weight?

A If the intent of the question is does it cause a particle to float, my answer would be, probably not.

Q But it might be?

A I suppose it is possible.

Q Why?

THE COURT: Let us dwell on probabilities. Anything is possible.

BY MR. FERGUSON:

Q If you have a rain storm and you have sheets of water going over the impervious surface with crank case oil on it and gasoline and other products from automobiles, et cetera, which goes into a lake, my layman's observation is that it creates a scum of oil and tends to float? Am I right or wrong?

A Your layman's observation may be based on a sheet flow of water across a parking lot, or it may be based on the illegal discharge of large amounts of oil down a storm sewer from a gasoline station in which case the conditions are different and are not comparable.

If you have an automobile oil change, you are taking five or six quarts of oil out of the automobile and the gasoline station owner may very well pour it down the storm drain, in which case it reappears in the lake. The amount of oil is greatly in excess of the amount of settlement which goes into the storm sewer, and in which it would appear as scum. I can conceive of that, but I cannot conceive that I can agree with that, but I can conceive that the washoff from a parking lot would necessarily appear as a scum. It is possible, but it certainly is not comparable in the same way as the pouring of large amounts of oil.

Q Incidentally, isn't this a very common way of getting rid of oil at a gas station?

A It is.

Q You said there is a 108-day detention time in the lake?

A That is the average detention time, yes.

Q Do you mean by that that the cubic feed of water poured into the lake will be held there for 108 days?

A Over a long term average, yes.

Q If you have a heavy rain and the stream coming into the lake is increased in its flow and you have pollutants floating on top, what happens to those

pollutants floating on top? Don't they rise over the lake and over the spillway?

A If there were pollutants floating on top?

MR. LINDEMAN: I object to the question because it is a hypothetical. It contains the condition that pollutants are floating on top and we have not had any testimony in this case about pollutants floating on top.

So, I think it is merely posing of a question.

MR. FERGUSON: I assumed that as a hypothetical foundation for the question.

MR. LINDEMAN: I do not think it is fair that such a hypothetical is propounded.

THE COURT: We are getting down to the end and I think it would be patently unfair to assume a fact that is not in evidence.

BY MR. FERGUSON:

Q 108 days is how long it takes to fill the lake?

A On an average flow condition, it would take 108 days to fill the lake, yes, sir.

Q And that is where you get your detention time?

A That is the way it is computed, yes.

Q Do you have an opinion as to the likelihood of any cubic feet of water coming in and how long it will stay there if the lake is full?

A Under average flow conditions it would take 108 days with the corrections for seepage out and evaporation. My computation was merely the average flow of the volume of the lake and relating it to the two and getting a value of 108 days as an average detention time in that lake.

Q What about the mixing of the various layers in the lake?

A Sir, I said an average detention time. Some is going to go through sooner and some is going to go through later. It is simply the hydrodynamics of the flow into the system demands. There will be some that would be less in time and some will be expanded in time.

Q What is the hyperdynamics of a ten year storm?

A Hyperdynamics?

Q With a storm runoff, a runoff coming into a lake? What is the detention time then?

A I have not computed that, sir. It depends. In the first place, it depends upon how full the lake is and if the lake were at the spillway level, the

retention time would be short. If the lake were less than the spillway level, there would be considerable flood storage available.

Q How short would it be if the lake was at the spillway level?

A I don't know. I would have to compute that.

Q Can you estimate it within a range which you are comfortable with?

A I would not be willing to attempt to do that at this time. I will estimate it in a matter of an average perhaps half a day. This is purely an estimate and I would rather not be held to that. I can compute and I can estimate it, but it depends. You see, the water to get over the spillway has to reach a certain level and when it reaches that level the water also spreads out on the banks that were previously dry. So, we have a so-called temporary storage of the water and above the spillway level and the methodology associated with that of what we term a flood reading through a reservoir is well established. There is no problem in doing it and if the hydrograph of the inflow were developed, the methodology of routing it through is straightforward and we could give you a reasonable estimate of the retention time in that reservoir.

Q Do you think that the order of the magni-

tude of something like half a day plus or minus is a big factor in an area?

A A loss or a minus is a large factor, yes.

Q Now, when you talked about your opinion that multi-family housing could be constructed with no greater detriment to water quality than single family homes, I would like to inquire of you what is the co-relation implicit in that opinion? Are you saying that one unit of multi-family housing can be constructed and would not have any greater adverse effect than one unit of single family housing?

A No. I didn't say that. What I did say is that the amount of pollution coming from either type of home at this time would have to be assumed to be equivalent. There is no data and support to the contrary.

Q Are you talking about a unit?

A I am talking about a unit, right. That is what I say.

Now, with the proposed multi-family dwelling there would be a good control of storm water runoff, indicated by the development of a lake and a retention pond.

Q We will get to your assumptions about controls and structure solutions that are necessary.

A All right.

Q What I am trying to get at is just the basic equation that you are making. Are you comparing one unit of multi-family with one unit of single family?

A At this point in time that is the best estimate we can make, yes.

Q In your report, you said, I believe that is the state of the art?

A That is correct.

Q And so for the moment you are rejecting General Whipple's conclusions?

A I am.

Q And you are saying that the state of the art is that one unit of multi-family is about the same as one unit of single family in terms of pounds of pollutants and in storm water runoff?

A This is the best estimate we can make at this time, yes.

Q Now, in terms of acres of ground, wouldn't it be true that the number of pounds of pollutants to come off 20 acres with one house every five acres is significantly less than pollutants that would come off of 20 acres with six units per acre of multi-family housing?

A Based upon my assumption the answer is, yes.

Q And it is fairly easy to quantify that? All you do is count the number of units?

A According to my basic estimates, yes.

Q So that if you had in my example one house for every five acres on 20 acres, you have four houses?

A That's correct.

Q And if you have six houses per acre for 20 acres, you would have 120?

A That's correct.

Q So, the ratio would be four to 120?

A Yes.

Q In terms of the gross amount of pollutants coming off the certain piece of ground?

A That's correct. Your arithmetic is correct, yes, sir.

Q What happens when you chlorinate the hydrocarbonates?

A The result is a chlorinated hydrocarbon.

Q And what is that?

A It is a compound in which one of the hydrogen atoms has been replaced by a chlorinated atom.

Q Is a chlorinated hydrocarbonate a carcinogen?

A There are tens of thousands of chlorinated

hydrocarbons in which perhaps some 20 have been potentially identified as carcinogenic, yes.

Q Are you aware of the E.P.A. recent announcement which would seem to require that New Jersey water supply facilities install filters to screen out chlorinated hydrocarbons which may be carcinogens?

A I am quite aware of it.

Q Have I stated it correctly?

A Quite correctly.

Q Is it cheaper in terms of dollars spent in a system analysis point of view to prevent hydrocarbons from going in and becoming chlorinated, or is it cheaper to build a filter at the end of a pipe to take them out?

A The assumption is that it would be cheaper to prevent their intake to the treatment plant, but if I may add to that, the so-called hydrocarbons which become known generically as high contaminated hydrocarbons are given a term which is called precursor. A precursor is any organic compound in common usage today, which upon chlorination results in the formation of a chlorinated hydrocarbon and the most common one is chloraform.

Now, many of these precursors are natural

products that wash off of the land when it is a farm land or a wood land or a person's front yard and, certainly, is not limited to hydrocarbons, which could be considered storm water runoff from a particular housing site. They are there irrespective of the use of the land because they are the natural recurring compounds in chemistry, which is quite complex but can be defined, if necessary.

Q Isn't it true that habitations, including multi-family and single family habitation close to a water course, will as a result just of their being there put pollutants, including hydrocarbons, into the water course?

A That is correct.

Q Would a non-structural solution to the problem of keeping pollutants out of the water course be to not build anything there at all?

A The best solution would be to build nothing.

Q In terms of cost for structures that would be the least cost solution?

A Correct. May I add parenthetically, Mr. Ferguson, that water quality is going to be degraded by the activity of a man on the land. There is no question about that.

Q Now, if we are talking about the cost to

this system as a whole, isn't it a less cost solution to have less intense development close to the water course and to put you more intense development in terms of the number of units per acre at a greater distance from the water course?

MR. LINDEMAN: Just one moment, please. I really object to that question because I think that it really calls for an explanation; if the foundation of it is purely as to dollars that are required to construct, as opposed to economic return that may result from that which is constructed, then, I think that the question ought to be clarified because, otherwise, the answer is itself inexorable with the more you build. You do not need an expert to tell us that the more you build the higher the cost and the less you build the less the cost, but if it is in terms of economic return, then, you have got a different subject.

MR. FERGUSON: An economic return of the land is not included.

THE COURT: Assuming that, Doctor?

THE WITNESS: Will you restate the question?

BY MR. FERGUSON:

Q Ignoring the economic return on the land, isn't the least cost solution to the problem of preventing water pollution to put your more intense development as far as you can reasonably get it away from a stream or a water course?

A The storm water runoff, which I presume is the topic under discussion at this time? That is incorrect.

Q Will you confine it to storm water runoff?

A Okay. In which case the water is going to get to the stream, whether it separates from 100 yards or 500 yards from the stream itself. The water is going to get to the stream. That outlet for the water is the stream itself.

Q Why do you say that?

A That is the only place that water is going to go. The majority of the storm water runoff is going to end up in the stream and only a portion of it is going to infiltrate into the ground. Once it hits the drainage channel, the rate of loss due to infiltration is infinitely reduced and if we have a large development there will be a drainage channel and there will not be a sheet flow across the surface of the land.

Q Isn't it true that more land that flows

over one way on there the more pollutants will get filtered out?

A If it were flowing in the form of flowing across a turf and in a front yard, the answer is yes. However, once it reaches the drainage channel the residue to infiltration or the filter traveling over the land is not going to be significant. A drainage channel is a ditch or a pipe and the water is simply going to go down that ditch or that pipe.

If one could assume that the sheet flow predominated, the answer to your question is yes, but one cannot assume this unless you have specifics in the design of the particular drainage system and construction.

Q Cannot you handle the storm water runoff with dry retention basins which do not discharge into a stream by constructing a retention basin that has adequate storage capacity to handle the proper definition of a storm, whether it be a ten year or a twenty year or whatever, so that a significant percentage of some place above 50 of your storm water runoff would be contained and not discharged into the stream?

A Mr. Ferguson, I am afraid I failed to describe what the dry retention pond was.

A dry retention pond is one which customarily

holds water back. The water has to go some place and it is going to go to a stream. It may go to a stream over a period of 24 hours in contrast to over a period of two hours, but it is going to get to the stream; but if we have the advantage of a retention pond in terms of storm water quality, in addition to reducing the flood peak that is distributing the water into the stream, that, in addition to that, there is going to be this retention which permits a particular matter to settle out in the bottom of a pond.

Q I am talking about the site for development which is not on the banks of the stream. I am talking about a development which is built a mile from a stream.

A The discharge would be into a drainage channel most likely.

Q Then, down to a stream?

A Well, if you are looking at Chester Township, the topography is such that drainage channels are in fact dry streams.

Q Chester Township is in fact riddled with streams all over?

A That is correct.

Q It is difficult to find any place that isn't that far away from a stream?

A That is correct. Therefore, your question is--well, excuse me, I apologize if I criticized your question. I didn't mean to.

Q Turning for the moment to eutrophication I noted that in your report you stated that "There is uncertainty that this lake would eutrophicate."

A Yes.

Q However, in hot dry summer months algae growths could occur?

A That is correct.

Q That is the same as your testimony today? I was not quite sure of the word you used as to the prediction whether it would in fact--well, it would be helpful if you would try and explain the two sentences?

A The estimates made of the eutrophication are based upon the amount of phosphorus added per square meter per year. That is related to the surface area of the water and the depth of the water and the observations have been made that if one relates the following, that is, the depth of the water to the retention time of water in the pond the one variable duration to the amount of phosphorus being added per square meter per year, one would locate himself on a photograph, a plot which is indicated on one of the

references in my report.

At this time with the information available and using 108 days of retention time, the eutrophication is not certain. However, in response to the next sentence that during the summer months--

Q Can I just go back for a minute? Okay. Go ahead and finish.

A During the summer months if the stream flow is low and if there is significant evaporation, the retention time is going to be longer than 108 days and in which case the phosphorus geometry relationship will shift into the eutrophic state.

Please note that the words used in the report are imperically determined. They are not scientifically defensible in all instances, but based upon the kinds of experience that have been collected over some 40-odd years. Now, this seems to be a reasonable state of art approach. So, it is not certain it is going to eutrophicate under conditions of average detention time and so forth, but the possibility of those conditions changing significantly during the summer may very well result in algae growth in the pond.

Q What was your base data as to the amount of phosphorus coming in?

A I took Mr. Lloyd's data and averaged the values

that he presented, this being the phosphorus data in samples taken at the Caputo site.

Q What did you add to it?

A I added nothing to it.

Q Did you add anything to the phosphorus coming in and forming the water runoff?

A No. I did not.

Q Shouldn't you have?

A That is the reason I said that it is uncertain in time, but it could happen. I stated in the report that I did not add this. I did not hide that fact.

Q I am not suggesting you did.A Personally and in my opinion I would be surprised at all to see an algae growth in that pond in the hot summer months. I stated that in my report.

Q You stated that it could be controlled with herbicides?

A Algicides.

Q How much algicides have to be put on it to control the algae growth?

A Algae comes in many, many species. Primarily planted, but many of them are blue green and some are brown and the time varies from cold weather and you may see the growth of algae and discover them in water up through the very hot weather, the water algae and

tapering out with the recurrence of cold water algae, which takes place in the months of November or December, when algae could be present. Now, obviously, they are going to be much more in evidence during the warm months because that is when the biological systems grow best, in warm water.

Now, in blue-green algae, if one wanted to drink it there is a possibility that there could be toxicity from the algae.

Q What about if humans were swimming in it?

A It is highly unlikely that there would be any problem of blue-green toxicity in humans. They simply do not drink that much water. There is no algae used in the standards for public drinking water. The standard EPA drinking water standards have no designation and there is no designation of algaes included.

Q In your opinion it might be necessary to use algicides?

A If one wishes to clear up the water it would be necessary.

Q What happens if you do not clear it up?

A The algaes will grow.

Q And what condition does that produce?

A There would be a subsequent algae growth in the lake, yes.

Q Can you touch it? Does it smell?

A I am sure, Mr. Ferguson, that both you and I see algae in a pond, yes.

Q The record does not reflect that. Is it apparent and is it visible and is it there?

A Yes. It is.

Q What does it look like?

A It looks like a green growth in the water.

Q Does it have any odor?

A If it decomposes, it would have an odor, yes.

Q How likely is decomposition or conditions that would lead to it?

A If it got sufficiently dense in the water, it could upon cold weather settle to the bottom and decompose, yes.

Q How do you apply the algicides?

A By spray most likely. Spray it on the surface, if it is liquid. If it is in solid form, it would be dragged in a porous bag behind a boat by applying it in liquid form. Spray would be the preferred method to insure the best coverage. Algicides would be used prior to the proliferate growth in the water. Good management would not let it grow.

Q How often does water have to be sampled to ascertain whether algae would not in fact be growing

when conditions would be ripe for algae?

A Many allergists would probably take sampling every couple of weeks in the spring months and identify and count the organisms and estimate whether or not a potential toxic growth is there, at which time they would then suggest, and a suggestion would be made for the application of the algicides.

Q Speaking of the many allergists, I notice that one of your references was as to the testimony of Ruth Patrick?

A I read the testimony, yes.

MR. FERGUSON: I would ask counsel if there was a transcription of Dr. Patrick's testimony in this case?

MR. LINDEMAN: It was not a transcription. That was a report that was furnished.

MR. FERGUSON: Excuse me.

Q Do you agree with any of the conclusions reached by Dr. Patrick?

A No. I did not.

Q The crux of your report is that with good design control and maintenance it would be possible to construct those multi-family dwellings on the Caputo tract, which would have no greater and possibly lesser impact on the water?

A That is what I wrote, yes.

Q I am going to ask you if you as a good engineering scientist carefully used and picked the word, possibly?

A I did.

Q Is it not true that it is a function of how good your structures are that you build to take care of the problems which inevitably flow from developments so close to a stream?

A Your question is a fair question.

Q I would ask you whether you have an opinion as to the comparative costs involved when you locate developments--and I am speaking now about the costs for structures needed to take care of the water pollution problems--do you have any opinion as to the costs involved and whether they can be lowered or raised depending upon where you sight the land use such as multi-family developments?

MR. LINDEMAN: I object on the ground that this witness has not been qualified on the subject of costs of construction, as such, and he may be but I have not qualified him as such. I didn't even ask him that.

BY MR. FERGUSON:

Q Well, as an engineer have you had exper-

ience in dealing with the comparative costs of structures to deal with problems to combat water pollution?

A I have.

Q Do you understand my last question? Basically, is it cheaper or more expensive to locate in terms of things you have to build to take care of the problems you create if you build dense developments next to a water course or further away?

MR. LINDEMAN: My objection goes to relevance.

THE COURT: I will allow it.

THE WITNESS: Would you repeat the question?

MR. FERGUSON: Mr. Reporter?

(The Court Reporter read the pending question.)

THE WITNESS: Well, there is no straightforward yes or no answer to that. In either case if there is a dense development, there is going to have to be structural control to prevent water pollution in the stream and I believe your question was: Would the structure be cheaper if the development were further away from the stream?

Q That is a good paraphrase. I will accept

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that.

Can you answer that question?

A The answer is that I do not believe that there would be a significant difference in cost. I say the same type of pollution control is going to be required, whether it be a retention pond or a sewage treatment facility or water treatment facility, I do not see that that question can be answered in a straight yes or no answer. In this case structure would be significant in both instances.

Q Could you give us an example of things that could change that could make a structure less expensive?

A For instance, if you did not have a stream that you could build a dam across, that would make a difference in terms of what you did with the storm water.

Q Let us take these items that we have discussed today one at a time. If you selected the westernmost R.N. zone in the ordinance, do you have an opinion as to whether the structures that would have to be built would be more expensive or less expensive in a general comparative sense?

A I would say the cost of the structures would be the same.

Q The cost of the structures would be the same?

A The center R. M. zone is located right at the headwaters of the stream itself. It is right there. One cannot rely upon that segment of a stream to perform anything that the structure would not be required to perform.

I might also mention at this time, Mr. Ferguson, that waste discharge from the center and at 40 per cent of the eastern zone would discharge into the Peapack Brook and flow directly into the reservoir of Peapack-Gladstone Water Company. The Caputo tract is downstream of that.

Q If you assume that the water goes directly from the storm collection system into the brook--

A There is no other way for it to go, sir.

Q If you have a device built for the over-land flow of the water, less of it goes ultimately into the brook? If you had a dry retention basin to store the water, it gets, in effect, treated before it goes into the brook or the lake?

A The answer is that the dry retention pond does reduce the pollutants that would go into the lake, yes, we agree.

Q Referring for the moment to the steep

slope, wouldn't it be true that the more that leaves the ground the less expensive your erosion and sediment control precautions could be?

A Yes.

Q And the steeper the slope is the more dollars it is going to cost to take those precautions?

A That's correct. I agree.

Q Would the same general statement be true about soil types? There are some soil pipes that are more subject to erosion than sedimentation because of the inherent nature of the soil?

A That is correct. We agreed on that an hour ago, I believe.

Q Turning to General Whipple's report, you said that there are relly four areas with which you disagree with General Whipple. The first was that there was no linear relation on the log-log plot, is that correct? I probably misstated it, so you can correct me if I am wrong.

A You did misstate it. There is not a linear relationship on a log-log plot of depth of water in a flow in a storm sewer and discharge of water. That is volume of water, the volume floats, the volume of water.

Q You say that because you are measuring,

in effect, the water in a circle, the pipe?

A That is correct.

Q And it has to do with the geometry of a circle?

A And, also, with the amount of surface area wetted, what we term the perimeter of water as a cross-section area of water, as related. If I may illustrate? When water is very shallow in a pipe a great deal of that water is in contact with the rough surface of the pipe.

Q So, you are talking about friction?

A Correct. If the pipe is half full, proportionately, a lesser amount of water is in contact with the rough surface, that is, friction.

A The less water in it the more friction there is?

A The greater effect of friction, yes.

Q Is it your testimony that General Whipple did not allow for friction coefficients?

A The testimony is that the young man explained to me how he estimated the discharge of the water in the storm sewer.

Q What young man is this?

A James DiLouie, who collected data for this particular report, and he explained that he calibrated the discharge depth relationship by several readings

through a straight line, drew a straight line on the log-log plot and relating the depth of water to the discharge of the water and extrapolated that data, that line, rather, to depth values different than the ones that he calibrated.

Q And this is depth?

A Yes.

Q And this is what (indicating)?

A Discharge, Q.

Q Quantity? A Yes.

Q And you take the depth and you take the quantity and you get the log rhythm of each?

A Correct.

Q So that is Log D and Log Q?

A Yes.

Q And you told me this before the break, but the General's plot looks something like this?

A Mr. DiLouie said so, yes.

THE COURT: Let the record show that Mr. Ferguson is drawing on the board and we will mark that exhibit when he completes it.

BY MR. FERGUSON:

Q Now, will you tell us what General Whipple did with this that is wrong?

A Just one moment and I will get out the corrected

lines.

Q Yes, please do. I have D-37 here I would give you.

THE COURT: Let him mark this in red, since you used a green.

A May I correct the green line to be more consistent with the scale that was used?

Let me get this down into here first.

The calibration curve that was used on the particular 42 inch storm sewer at Twin Rivers was approximately as shown on the diagram here, this being the log rhythm scale. If you notice, it goes from 1 to 10 and these data are in cubic feet per second for one point, at this point to 10 to 100, which is by definition a log rhythm.

Similarly, we go from 1 here to approximately 10 at this point. Again, it is the log rhythm plot. Now, what determined the geometry of the circular pipe and what determined the discharge equation commonly used in open channel flow, is Manning's equation. I estimated that the shape of the curve should be approximately, as indicated on this sketch, so that if one were to use this green line and read the depth across here and then come down to read the discharge, he would in fact be reading a value which is

not the same value as one would obtain by using a curve. This should be a curve here and the depth discharge relationship would be more closely this value, which is larger in terms of amount (indicating).

Q Could I interrupt to ask you a question? You said you got your line from Manning's Formula?

A I got it from a combination of the geometry of the circular pipe segment and from Manning's discharge equation, yes.

Q Manning's discharge equation is for what?

A Open channel flow hydraulics.

Q Does it depend upon what kind of pipe or channel it is going through?

A It certainly does.

If you would like, I would explain the equation, or it may not be necessary in this case.

It is the equation that is used in design analysis of all sewer, open channel hydraulics.

Q You made allowance for the cross-section of pipe?

A By necessity, yes.

Q Go ahead.

A There is nothing more to add except that of the assumption that the calibrated values obtained by measurements in a storm sewer could be extrapolated

and resulting in a straight line. This straight line would then be used to relate the measured depth of water to discharge of the water.

Q Now, is it correct to say that General Whipple and a student used this line because they identified a constructed line by drawing it through the values which they found?

A That is correct.

Q And you got your line by calculation? Am I right or wrong?

A You are right.

Q Did you relate your line to the observed values?

A I did.

Q And did your line go through observed values?

A It went through in the middle, as my red and green line is here.

Q So, your line agreed with it up here?

A Because at one point, like a stopped clock, it is right twice a day, down here and up here, and crossed at one point here.

Q Let me take this-- It is right there?

A Where it is in green (indicating).

Q Did the values measured fall on your line?

A The values measured did not.

Q By General Whipple?

A Not if my line is not the same as his line. The values could not be the same except at the point of intersection, which is the unique point.

Q Was your line based upon empirical data measured at the Twin Rivers project?

A It could not be, of course. No. I did not measure any data there.

Q You did not use General Whipple's measurements data to construct your line?

A I did not.

Q Your line was constructed from the assumption of the Manning Equation adjusted to the semi-circular shape of pipe was the right equation to use?

A Sir, it is an equation that all hydraulic engineers use. The assumption that a depth discharge relationship and circular pipe can be simulated by a straight line is theoretically and practically incorrect.

We are now talking about the experiences of hydraulic engineers over a period of three or four centuries, as related to half a dozen readings plotted on a piece of paper through which a straight line was drawn and the data was then, that line was just

extrapolated beyond the points of measure.

Q Now, could you from your line determine the magnitude of error of General Whipple's measurements?

A If I wished to do so, I could give an estimate, yes.

Q Can you estimate the magnitude of the error caused by this?

A I cannot without a little time to study it.

The point that I would like to make, Mr. Ferguson, is whether the error is very significant or partially significant is one point of contention. If the basic approach used was in fact in error, the coincidence of the data is fortunate; however, not acceptable in the engineering profession.

Q I do not understand the last statement.

A All right. If two people got the same answer and used entirely different approaches, the fact that they got the same answer was coincidental than if the two approaches were significantly different. That does not mean that both are equally acceptable as engineering procedures. One is more correct than the other.

Q I understand. Now, this sheet that you have given me is what?

A The straight line was given to me by the young man, Mr. James DiLouie; and the circles I have drawn in

there myself, and I went over this with Mr. DiLouis. He has a copy of this, incidentally.

Q And this is from the paper about which you testified earlier?

A The straight lines? The straight lines on that paper, which is the paper which General Whipple submitted, this is the approach he used in estimating discharge.

Q May I mark this for identification, or is that part of that document which you prefer not to have marked?

A The straight line is part of Mr. DiLouie's data base. He has not given it to me in final form yet. So, I would say it is in a similar category as the other. The dots on there are my own and you are more than welcome to them, but the straight line information was given to me by Mr. DiLouie.

Q When did he give it to you?

A He and I were in conference between 10 and 12:30 on the 20th day of February.

THE COURT: Let the record show he is referring to his pocket diary.

THE WITNESS: I know this is correct, because that was a holiday and Mr. DiLouie had the day off.

BY MR. FERGUSON:

Q Did he orally tell you the information necessary to put in that information?

A Mr. DiLouie plotted the straight line values on that piece of paper, at my request.

Q He stated these were the values used in preparing General Whipple's study?

A He did, yes.

Q Do you know if those or if that kind of thing was done before General Whipple wrote his report? Were those plotted on a piece of graph paper?

A They must have been, otherwise he would not have been able to have written the report.

Q As a matter of fact, Mr. DiLouie did the computations that are in General Whipple's report?

A He did not get to it, I might add.

Q The next area you said you disagreed with was that Mr. DiLouie told you he hung upside down inside a manhole to do one of the measurements?

A Yes, sir.

Q What measurement was that?

A Referring to your document, sir, let me find my own. It was the storm that was on the 6th day of August, 1976.

Mr. DiLouie told me that the water was approxi-

mately 20 to 25 inches deep in a 42 inch sewer. It was rushing at a very high velocity and he was unable to measure the depth of water in the sewer with his probe because the water was coming so fast he could not do it.

So, he estimated the depth of water in the sewer at the peak discharge value. Now, he may have measured when the water was at a lower or higher level, but that peak discharge value that he used was an estimate value depth that he used.

Q Did he think the estimate was accurate?

A He had no choice but to make an estimate, if he would have completed his data--

Q Why do you disagree with that methodology? What do you find to be objectionable about that?

The estimated depth of a sewer?

A Sir, the data that was obtained in such a manner was used to draw conclusions that in my opinion are not justifiable in view of the questionable data collection system.

Q Did he tell you how he estimated the depth? Did he say he measured from the top of the pipe down to the top of the water?

A No, he did not.

Q Did you ask him that?

A He said he estimated the depth.

Q Did you explore with him how he estimated it?

A No, I did not. He was a reasonably mature young man. If he said he estimated the depth of water in a 42 inch sewer, I took his word for it that he estimated it.

Q You did not explore with him in any way how he made that estimate?

A Sir, there is only one way to make an estimate other than measuring and that is to look at it.

Q Aren't there other methods of estimating such as trigonometric estimates or taking angles to find a distance?

A Sir, the manhole is approximately three feet in diameter. It would be difficult to make trigonometric measurements of water rushing through when standing on the rungs of a ladder in a manhole three foot in diameter.

Q When you first testified about this, you said he was hanging upside down from the manhole?

A One would have to--

THE COURT: You are really getting into a lot of detail. I don't think when there is a manhole that you are inside where there is

water pouring through, I don't think you walk down too far.

I wouldn't hang over if I were doing it. I would not hang over too far.

MR. FERGUSON: I will stop at this point, your Honor. I think I have made my point.

Q There is an equation on Page 3, Table 2, which is the Corps of Engineers, which equation says: R=C (p - f)? A Yes, sir.

Q How did General Whipple use it incorrectly?

A The scaled engineering "Storm Model Equation" is one that was developed by the U. S. Army Corps of Engineers for the purpose of estimating the magnitudes of runoff, and, also, the quality of water runoff; and in this instance we are merely using this to estimate the magnitude of the runoff of the rain into the storm sewer.

Q What do you mean by magnitude?

A The amount of water that runs off.

Q You are determining or measuring the amount in inches?

A That is what the equation said, R equal to runoff in inches, yes.

Q And just to be clear, that is the number

of inches overall in land in the basin?

A That is correct.

Q Which is what?

A Which is the composite runoff coefficient, referring to the fact that for the pervious area an average value of .45 was used and for the impervious area an average value of 0.90 was used.

Q Do you agree or disagree with those assumptions?

A These are crude assumptions, but I will accept them at this point.

Q What about "p"?

A P in this case is precipitation values that are used in computations. A rain gauge was installed in the vicinity of the manhole from which readings were taken, with the exception of the storm on July 23, 1976 in which case the rain gauge was not installed.

Q Where do you find information about the installation of rain gauges. Is that in the report?

A Reading if I may from the paper, which should be the same as yours: "Field crews went out on occasions when meteorological advice indicated that a storm was iminent, and started sampling prior to the first runoff. Samples were taken every 10 minutes until the storm runoff had passed its peak and became

inconsequential. Storms were measured over as wide a range of total precipitation and as much of the year as possible."

Q I am on Page 4. It says: "Rainfall was measured in a portable rain gauge on six of the seven storms."

A That is correct. In the first one the rain gauge was not used. That is the one I referred to on July 23.

Q Going back to the equation, precipitation is in inches and measured by a rain gauge except for one; and I guess estimates were made then, or wasn't used at all?

A Runoff was used. Runoff values were measured, but rainfall was not measured.

Q Okay. And F is what?

A F is termed urban depression storage.

Q Can you tell me what that is in 10 words or less?

A In the rainfall runoff relationship, that is, the hydrology of such, certain amounts of rain is reported to fill up a depression that is in the ground, parking lots and streets and yards and roofs and whatever it is.

Q Is the water collection before you get

any runoff? A That is correct.

Q What did General Whipple do that was wrong?

A The basic assumption he has made here in my opinion was wrong. The F equation, which was quoted in this case, the F value as described in the user's manual of his storm model equation is given in inches per hour infiltration.

The value that was used here for each individual storm value here was 0.5 of an inch. Depression storage was assumed for the entire calendar year.

In the vicinity of Trenton there are approximately 100 days of rainfall. One may be positive--and if necessary I will explain this in a few moments--that the amount of depression storage in the course of a year was considerably in excess of 0.5 of an inch. One could anticipate readily that even on a parking lot depression that storage would be close to .500 to 1/10th of an inch. Using the higher value, which General Whipple did, he used a value of 0.5 inch per year.

Let me repeat. If there were 100 rainstorms in the course of a year and in each instance visualizing, if you will, say five hundredths of an inch, if we then multiplied that times 100 rainstorms that would be five inches in the course of a year. I am referring

now only to parking lots. If we now refer to the turf, that is, the grass and the yard, the magnitude of the depression storage would be considerably in excess of that five hundredths of an inch, which is an extremely conservative estimate, and the values might very well be 2/10 of an inch of rain to fill the depression.

Q Are you saying that General Whipple used .5--

A For the entire year.

Q For the year? A For the year.

Q And you are saying he should have used a per hour figure?

A The engineer's storm model equation states by definition urban depression storage in inches per hour.

Q Did you go through the General's calculation to make sure that he did not allow for that in his classification? A I did.

Q What did you find?

A I found that he did not allow for that. If I may refer, sir, to the storm model equation user manual, Page 6. That is the identical equation and we have got urban depression storage in inches per hour and we have rainfall in inches per hour over the urban area.

So, what was done in General Whipple's paper was to take the total rainfall, which was estimated at 42 and 1/2 inches per year and he then took the urban depression storage estimate at 5/10 of an inch per year and quoted an equation which is based upon precipitation in urban depression on an individual rainstorm basis and the rate of precipitation and the rate of depression storage are given in inches per hour. The use of that equation to estimate it in terms of inches per year is to say the least the unique use of someone else's equation.

Q Did you estimate the magnitude of the error which would come out at the other end of the equation?

A I will repeat the discussion of this morning, if I may.

The total runoff which would come from the Millstone Basin is approximately 21 inches per year, or 20.47 inches per year over a period of some 20 to 40 years of data.

Q Is that in this report, or is that from some place else?

A That is from the stream flow records by the U.S. Geological surveys.

Q Did you go check that?

A I did.

Now, if one goes back to the equation which you have in hand here, what we are saying is the 42.5 inches, if we then subtract 5/10 of an inch, it gives us 42 inches per year rainfall minus depression storage.

Q On an annual basis?

A Yes. Down below I find in my paper that the average runoff on coefficients used was .55. Does your paper agree with that? I am sure it does.

Q You tell me.

THE COURT: Gentlemen, I will have to interrupt for the Grand Jury.

(After a recess on this matter, the following occurred:)

THE COURT: Go ahead. I am sorry I had to take this in the middle of cross-examination.

BY MR. FERGUSON:

Q I believe the question was: How would you estimate the errors resulting from these assumptions? Number 1: Did you estimate the error from what you just testified about annual versus the inches per hour problem? A I did not.

Q And what would you do to estimate it? Can you do it now?

A May I go back just a little now? The annual average rainfall on the Millstone River we will accept at approximately 42 inches per year. It is a little higher than that, but for this purpose we will accept 42 inches of average runoff as 20.47 inches. The difference results from the so-called E, evapotraporation?, that is use of water by land plans and, also, by evaporation from the water surface.

This means, then, that the difference between the rainfall and the runoffs results from evapotraporation. If one takes the values that are given in this report, one has the 42 inches minus 5/10 of an inch, which was the rainfall minus the depression storage, multiply that value by the average coefficients of runoff of the C values in the equation, which he has indicated there as varying between .51 and .54, then applying that coefficient for 42 inches I come out with about 23 inches of runoff from this land due to direct storm discharge because what was done was to take the 42 and 1/2 inches and subtract 5/10ths and multiply it times the coefficients of runoff to get the total storm discharge, which was something over 20 inches per year of direct storm discharge.

Now, inasmuch as the total discharge from the Millstone River Basin is less than 22 or 23 inches,

plus the fact that the infiltration was approximately 55 per cent over 69 per cent of the land area, one must come to the conclusion that an inadequate count was taken of the fall-away. the Millstone River will run even though it has not rained for some time. The water that is recharging the Millstone, or any other river, comes from the ground water feed to the river itself.

If, in fact, the Millstone River does run during the period of dry weather and if, in fact, the total runoff is just a little over 20 inches, one must assume that part of the rainfall that occurred during the storm periods did not in fact occur as direct runoff during the storm periods. May I attempt to clarify that?

Q Yes, please do. Well, can I just paraphrase that and you can tell me whether you agree or disagree?

Are you saing that because the Millstone River runs even with no rain that there has got to be lots of runoff feeding the river?

A Indirect runoff through the ground infiltration feeding the river, yes.

Q Is that the sum and substance of the error which you have been testifying about?

A May I continue to make sure that it is in my words and not yours?

Q Yes.

A Therefore, one must conclude that the magnitude of the direct runoff from storms, estimated by Whipple as 22 or 23 inches, is in error because if, in fact, all of this runoff did occur during storm incidents, there would be no water left for recharging the Millstone River during periods of low flow. Now, in an attempt to make estimates--

Q Okay. Just let me interrupt here if I could?

A Right.

Q Is that the sum and substance of it? Is that your best explanation of the error resulting from the misuse of this formula?

A It is one of several major errors.

Q I am talking about this particular formula, the Corps of Engineers' formula?

A The formula was misused, grossly misused, which is in fact an error, resulting in data and C computations using this formula, which resulted in data which must be in error because I repeat that the Millstone River runs even if it has not rained.

Q Now, you were about to add something and I interrupted you. Please go ahead.

A The one way we could, if it were desired, we could actually go and get the storm hydographs at gauging stations on the Millstone River near this particular site, or a site similar to it.

Taking the area under those hydrographs, would permit us to estimate total storm discharge, total discharge from the storm directly. I am estimating here and, again, this is a pure estimate, that approximately 50 per cent of the runoff, total annual runoff from the Millstone River comes in the form of direct storm runoff itself, and the other 50 per cent is coming from recharge of ground water. So, the estimate, crude as it may be, is that the loading rates indicated here, even if all other data were correct, are probably off by a factor of 2. He is thus reading numbers which are in the table in there, reading numbers of BOD on an annual average basis of 88 and phosphorus of 39, and I would dare venture to guess that these numbers are off by a factor of 2.

This is my estimate. I have not made any attempt to do this, but based upon general hydrological knowledge of the Millstone River Basin, which, really, of course about 30 per cent of this area of Twin Rivers is impervious, I would say that these numbers are, perhaps, off by a factor of as much as 2.

Q Is there any other possible explanation for the fact that the Millstone River continues to run in dry periods?

A There is no other source of water. Mr. Chasey discovered this in the 17th Century.

Q There is no ground water in the Millstone River?

A There is no ground water. The ground water feeds the river, but ground water comes from infiltration of rain water.

Some years ago, there was arguments on the same river as to where did this water come from that seem to run during periods of dry flow and Mr. Chasey had to prove in the 17th Century that it was as just described, from ground water recharge. People had elaborate streams of water coming from the ocean and through caverns and rising through the lands.

Q And you think that the Millstone River must be recharged by storm water runoff in infiltrating through the ground?

A That is the only way. That is the only source of water to any river.

Q And that means, once again, that General Whipple has not taken account of that?

A He has not taken account of that in his compu-

tations.

Q Should he have taken it into account?

A In failing to do that, failing to take this into account, he has assumed the total runoff occurred during storm discharge; in other words, the runoff occurred during a period of that storm.

Q There must be runoff other than that storm? Is that what you are saying? I fail to follow.

A I don't understand your question.

Q I cannot ask the question because I do not understand the point you are trying to make.

MR. LINDEMAN: Perhaps we ought to drop it then.

BY MR. FERGUSON:

Q Let us move on to the extrapolation of 2 to 22 by factor of 11. Would you explain that?

A At least by a factor of 11, yes.

Q Where in the report does that occur?

A Totalling the amount of runoff, measured runoff, from seven storms listed in the report, added up to less than two inches.

Q Two inches over the entire basin?

A Correct, and from each of these individual storms.

Q Let me paraphrase it: If I understand it

correctly, General Whipple assumes an annual runoff is equal to 22 inches and he extrapolated on the basis of 2 up to 22?

A That is correct.

Q You do not think that is a valid extrapolation?

A I do not.

Q Can you briefly tell us why not and how much data you would have to have to make a valid extrapolation?

A Just one moment, please. One of the earliest studies that was done on this kind of work was done in Durham, North Carolina. It is reported on Page 195 of the reference on non-point source of runoffs, non-point source of urban pollution. I cannot find mine.

THE COURT: Reference 4?

THE WITNESS: Yes, Reference 4.

The people who did this work sampled a total number of storms in a year and one-half equal to 36 different storms. I have not added up the total amount of inches, but if you would like to wait for just a moment, I will give you the estimate.

Q That is all right. Time is short.

A Somewhere in the order of between 12 and 20 inches of runoff in a total of 30 storms.

So, in an attempt to answer your question, I would say that there ought to be some 30 to 40 samples taken and more accurately measured, I might add, before I would accept the conclusion that came from this particular study.

Seven is a grossly inadequate number, perhaps, by a factor of 5.

Q Is it your testimony, then, that you believe General Whipple's report is not supported by the methodology? You are not saying, are you, that he is wrong? It is that he has not proven to your satisfaction that he is right?

A I believe I stated in my report that the conclusions reached are not supported by the evidence given, the evidence being inadequate and questionable accuracy in the misuse of the equation and extrapolation of engineering data by a factor of 11, which is normally not acceptable. It is comparable, if I may repeat, to making a traffic survey of seven days in a period of a year. It is grossly inadequate, from which to draw conclusions.

The idea of the study is good and ought to have been done, but not conclusions of this nature.

Q As far as you are concerned, the data in inadequate to prove General Whipple wrong in his

conclusions? There is not enough adequate data there to form any conclusion at all in your opinion?

Well, I will withdraw it, your Honor, if he stated it.

THE COURT: He has given us his opinion.

(Whereupon this witness was excused.)

MR. LINDEMAN: I would offer P-49 for identification into evidence.

MR. FERGUSON: With those exceptions as relates to the names and site plan aspects?

THE COURT: I think I will allow it to be marked into evidence.

(P-49 for identification now marked P-49 in Evidence.)

MR. FERGUSON: D-37 ought to get into evidence, too.

MR. LINDEMAN: I am surprised it is not in evidence. I think it is marked in there.

MR. FERGUSON: Let me see. I have it marked for identification.

THE COURT: Do you have any objection?

MR. LINDEMAN: I have none.

(D-37 for identification now marked D-37 into evidence.)

MR. LINDEMAN: I would also mark P-49

into evidence.

MR. FERGUSON: I would also object to the testimony of this witness insofar as it relies upon the documentation of the work of somebody who is not here to testify, and that is the student.

THE COURT: The student himself?

MR. FERGUSON: Yes.

THE COURT: If that is the case, then, I think you have got to survive on General Whipple's testimony then, Mr. Ferguson, and if you want to do that, fine, I will take both out and where does that leave us?

MR. FERGUSON: No. I think that is reasonable.

THE COURT: What Mr. Ferguson has drawn with corrections by the Doctor in red, will be marked as D-82 just for identification.

Do you want about a week to draw up those corrections?

(At this point there was an off-record discussion, after which the following occurred:)

MR. FERGUSON: Two weeks would be like tomorrow.

THE COURT: It is almost tomorrow.

How much time do you want? About three weeks?

MR. FERGUSON: Yes.

THE COURT: Okay. That is about what I planned to give you in the beginning.

Put it down on the record that the factual resumes and summations are to be in on Friday, April 7th.

(Whereupon, this case was terminated.)

I, Frank E. Nolan, hereby certify the foregoing.

Frank E Nolan

Official Court Reporter.