ACTION

COMMITTEE		DATE
M.A.P.C.	Accept the report Forward to ECC	9-9-82
E.D.C. (Economic Dev. Comm.)	~~B.C.C./B. CO. C.~~ Approve the report and forward to B.B.L. with 3 fold recommendation.	9-23-82
B.C.C.	Approve the report with 3 fold provision.	10-12-82

MORE COMPLETE STUDY

INFORMATION IN STORAGE

WITH SUBDIVISION FILES

FLN
10/82

DR 82-23 Cost-Effectiveness Study of Storm Sewer Pipe Materials

ACTION

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MORE COMPLETE STUDY

INFORMATION IN STORAGE

WITH SUBDIVISION FILES

FLN
10/82

DR 82-23 Cost-Effectiveness Study of Storm Sewer Pipe Materials

WICHITA-SEDGWICK COUNTY

METROPOLITAN AREA PLANNING DEPARTMENT

DATE June 24, 1983

TO David Stowe, Director, Operations/Maintenance

FROM Robert A. Lakin, Director of Planning

SUBJECT Storm Sewer Pipe Task Force

Yesterday the Storm Sewer Pipe Committee (by consensus I suppose) concluded (including our own engineering staff) that the Wilson contract was inadequate to meet the City's need, and more particularly the Task Force's desires, as they interpret their report. There is 2,300 dollars left in the Wilson contract, less yesterday's time for Chandler and Osborne.

It is not yet clear to me in how many ways the non-technical portion of the specs influence or dictate the content of the "tech" portion. Before you proceed or cancel the Wilson contract, I would like to meet with Lindebak and Schneider (and any others, such as yourself, 13th Floor, etc.) to:

1. Evaluate what the Task Force report really was.
2. What our people feel should be in a complete spec beyond tech material.
3. Whether to complete or cancel the Wilson work.
4. What parameters to establish on a draft scope of services to be returned to the Task Force (when do we pull Dekker in?).
5. How to finance a new study; and if done, do we extend Wilson or open it up and go through selection procedure?
6. Time schedule to return to Task Force.

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Robert A. Lakin
Director of Planning

RAL:FN:rme

cc: Robert Finch, Deputy City Manager
Mike Lindebak, City Engineer
Forrest Nagley, Junior Planner, Current Plans Division
John Wynkoop, Director, Water and Water Pollution Control

SANITARY AND STORM SEWER SPECIFICATION REVISIONS BY WILSON & COMPANY

COMMENTS:

1. Storm sewer pipe task force requested that sanitary sewer and storm sewer specifications be separated.

2. Revisions require all concrete to be air-entrained. Only concrete exposed to weather should be air-entrained.

3. Revisions require cement used in concrete manholes to be Type II. Why? This will require contractors and/or concrete suppliers to store two different types of cement.

4. It seems inappropriate for the specifications to permit the Engineer to order substitution of Type III cement for Type I cement without additional compensation since this will increase the cost to the contractor and/or concrete supplier.

5. Filter fabric should be required to be used with crushed rock bedding material to prevent infiltration of finer grained materials into the coarser rock.

6. Pipe bedding should be placed and compacted using hand methods.

7. Unacceptable large rock and clods in Type 3 bedding should be defined.

8. Why delete the section on cast iron pipe for storm sewers?

9. I believe the task force intended the minimum class of R. C. P. in standard specification to be identified as Class II.

10. The nominal dimension of C. M. P. must be ascertained prior to being able to determine the amount of deflection. How can this be done?

11. How can additional trench stabilization be anticipated so that this cost can be included in the Engineer's estimate?

12. Trench backfill to 12" above the top of the pipe should be hand placed in maximum 6" lifts uniformly on both sides of the pipe and compacted to 90% of standard density using hand operated compaction equipment.

13. It seems the task force questioned the integrity of sand filling, flushing, and vibrating as an acceptable backfill procedure for C. M. P.

14. Why has the requirement for constructing smooth channels on the floors of manholes been eliminated?

15. Specifications should read "All 4" and 6" clay pipe stubs shall be extra strength vitrified clay pipe."

16. Typographical error on page 29 - 12 1/2? Instead of 12 1/2°.

NON METALLIC - NON SHRINK GROUT

WICHITA-SEDGWICK COUNTY

METROPOLITAN AREA PLANNING DEPARTMENT

DATE June 7, 1983

TO Interested Individuals and Organizations

FROM Forrest L. Nagley, Junior Planner

SUBJECT Forwarding of agenda for June 23rd meeting of the Task Force on Storm Sewer Pipe Materials

Attached is an agenda for the June 23rd meeting of the Task Force on Storm Sewer Pipe Materials. The purpose of the meeting will be to discuss proposed changes to the City's "Installation Specifications for Sewers" as well as to review the progress made toward implementation of the Task Force's recommendations.

Should you have any questions, please call me at 268-4421.

Forrest L. Nagley
Junior Planner

FLN:bh

cc: R. W. Bruggeman, Director of Engineering
Darrel R. Brewer, Jr., Superintendent of Sewer Maintenance
John D. Wynkoop, Director of Water and Water Pollution Control
Claud Schelor, Director of Sedgwick County Department of Public Works
Douglas Hahn, Ph.d., Sedgwick County Department of Environmental Resources
Don Anderson, Director of Housing and Economic Development
David Stowe, Director of Operations and Maintenance
David Flory, 3202 W. 13th, 67203
James L. Gardner, II, Metropolitan Area Planning Commission, 601 N. Broadway, 67214
Joel Pollack, Economic Development Commission, 331 N. Waco, 67202
Don Gibbs, Millcon Corporation, 700 E. 29th St. North, 67219
Clinton Dunn, J and J Metal Products, Box 347, Paola, Ks., 66071
Mike Rice, J and J Drainage Products, Box 829, Hutchinson, Ks., 67501
Robert Reinke, ARMCO, 900 N. Tyler, 67212
Robert Meinzer, ARMCO, 5900 S.W. 29th St., Topeka, Ks. 66614
Darwin L. Christensen, Kaiser Aluminum, Suite A-170 5278 Pinemont Drive, Murray, Utah, 84107

SANITARY AND STORM SEWER SPECIFICATION REVISIONS BY WILSON & COMPANY

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OK

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AP "G" Pg. 26

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NON METALLIC - NON SHRINK GROUT

CONTRACT
for
ENGINEERING SERVICES
between
THE CITY OF WICHITA, KANSAS
and
WILSON & COMPANY
ENGINEERS & ARCHITECTS
WICHITA, KANSAS

THIS CONTRACT, made this 14th day of December, 1982, by and between THE CITY OF WICHITA, KANSAS, party of the first part, hereinafter called the "CITY" and Wilson & Company, Engineers & Architects, Wichita, Kansas, party of the second part, hereinafter called the "CONSULTANT".

WITNESSETH: That

WHEREAS the CITY intends to review and revise the technical provisions of its standard construction specifications for storm sewers and sanitary sewers; said review and revision hereinafter called the "PROJECT"; and,

WHEREAS, the CITY is authorized by law to employ Consulting Engineers to assist in the PROJECT:

NOW, THEREFORE, the parties hereto do mutually agree as follows:

I. SCOPE OF SERVICES

The CONSULTANT shall furnish engineering services as required for the review of the technical sections of the current City of Wichita, Department of Engineering standard specifications for construction of storm and sanitary sewers; for development of recommended changes thereto; and for preparation of the revised sections of the specifications in typed format. The CONSULTANT's review shall include, though not necessarily be limited to, consideration of the following references where applicable:

A. The report of the CITY's Task Force on Storm Sewer Pipe Materials.

B. Drafts of revised specifications previously prepared by the CITY's Department of Engineering.

C. The CONSULTANT's standard and special specifications.

D. KDOT standard specifications and practices.

E. Selected reference specifications from other cities, agencies or technical society publications.

In connection with the services to be provided, the CONSULTANT shall:

A. PHASE I - PRELIMINARY RECOMMENDED REVISIONS

When authorized by the CITY, proceed with the review of reference documents and the development of recommended revisions of the CITY's specifications. Submit preliminary recommended revisions in rough draft form, with accompanying explanatory notes, comments and references where needed, for review by the CITY's Department of Engineering. Meet with the CITY to discuss the preliminary submittal and review comments.

B. PHASE II - FINAL REVISED SPECIFICATIONS

When the Preliminary Revisions have been reviewed by the CITY, and resulting review comments and instructions have been received by the CONSULTANT, proceed with development of the Final Revised Specifications. When final documents are approved by the CITY, deliver the original typed text of the Revised Specifications and magnetic card recordings of the text prepared on IBM Mag Card II equipment.

II. IN ADDITION, THE CONSULTANT AGREES

A. To provide the various technical and professional services, equipment, material and transportation to perform the tasks as outlined in Scope of Services.

B. To notify the CITY when the documents for the PROJECT have progressed to the point that review may be conducted; to furnish the CITY with a reproducible copy of documents for use in reviews; to furnish one or more representatives to participate in reviews of the PROJECT; and upon return receipt, to expeditiously complete all changes, modifications and corrections to the documents resulting from the reviews.

C. To make available during regular office hours at its Wichita office all reference materials such as the CITY may wish to examine periodically during performance of this agreement.

D. To maintain books, documents, papers, accounting records and other evidence pertaining to costs incurred by CONSULTANT and, where relevant to method of payment, to make such material available at its office at reasonable times during the contract period, and for three (3) years from the date of final payment under the contract for inspection by the CITY or its authorized representatives.

E. To comply with all federal, state and local laws, ordinances and regulations applicable to the work, including Title VI of the Civil Rights Act of 1964, and to comply with the CITY'S Affirmative Action Program as set forth in Exhibit "A" which is attached hereto and adopted by reference as though fully set forth herein.

F. To accept compensation for the work herein described in such amounts and at such periods as hereinafter provided and that such compensation shall be satisfactory and sufficient payment for all work performed, equipment or materials used and services rendered in connection with such work.

G. To submit proper billings to the CITY for the engineering services performed as required by this Agreement. During the progress of work covered by this Agreement, partial payments may be made to the CONSULTANT at intervals of one calendar month or greater time span. The progress billings shall be supported by documentation acceptable to the CITY Engineer which shall include a record of the number of days to complete the work, the number of days that have elapsed, and the number of days that remain to complete the work. Billings submitted during the progress of the work will be paid on the basis of the costs accrued to the PROJECT plus a fee for profit based upon a fixed percentage of the CONSULTANT'S actual costs as provided in Article IV. Accumulated partial payments shall not exceed ninety-five percent (95%) of the total fees for services set out in Article IV prior to satisfactory completion of all work required by this agreement.

H. To complete and deliver preliminary and final documents to the CITY within the time allotted for the work as stipulated below; EXCEPT that the CONSULTANT shall not be responsible or held liable for the time required for reviews for the approving parties or other delays occasioned by the actions or inactions of the CITY or other agencies, or for other unavoidable delays beyond the control of the CONSULTANT.

1. Preliminary Recommended Revisions (Phase 1 - Article I, Section A) within 90 days after notice to proceed.

2. First submittal of Final Revised Specifications (Phase II - Article I, Section B) within 15 days after approval of preliminary documents.

3. Complete and final documents including any and all corrections required by the City Engineer shall be submitted within five days following the return of or comments on the first submittal of Final documents.

I. CONSULTANT shall procure and maintain such insurance as will protect the CONSULTANT from damages resulting from errors, omissions and negligent acts of the CONSULTANT, its agents, officers, employees and subcontractors in the performance of the professional services rendered under this Agreement and for which he is legally liable. Such policy of insurance shall be in an amount not less than $3,000,000.00 subject to deductible of $125,000.00. In addition, a Workman's Compensation and Employer's Liability Policy shall be procured and maintained. This policy shall include an "all state" endorsement. Said insurance policy shall also cover claims for injury, disease or death of employees arising out of and in the course of their employment, which, for any reason, may not fall within the provisions of the Workman's Compensation Law. The liability limit shall not be less than:

Workman's Compensation Statutory Employer's Liability $500,000.00 each occurrence.

Further, a comprehensive general liability policy shall be procured and maintained by the CONSULTANT that shall be written in a comprehensive form and shall protect CONSULTANT against all claims arising from injuries to persons (other than CONSULTANT'S employees) or damage to property of the CITY or others arising out of any negligent act or omission of CONSULTANT, its agents, officers, employees or subcontractors in the performance of CONSULTANT services under this agreement. The liability limit shall not be less than $500,000.00 per occurrence for bodily injury, death and property damage. Satisfactory Certificates of Insurance shall be filed with the CITY prior to the time CONSULTANT starts any work under this agreement. The CONSULTANT shall furnish the CITY copies of all insurance policies or certificates of insurance that relate to the insurance policies that must be maintained hereunder. In addition, insurance policies applicable hereto shall contain a provision that provides that the CITY shall be given thirty (30) days written notice by the insurance company before such policy is substantially changed or cancelled.

J. The CONSULTANT shall be responsible for the professional and technical accuracy and the coordination of all designs, drawings, specifications, plans, cost estimates and other work or material furnished by the CONSULTANT under this Agreement.

K. The CONSULTANT shall represent that all designs, drawings, specifications, plans, cost estimates and other work or material furnished under this Agreement, including any additions, alterations, or amendments thereof shall be free from errors or omissions. The CONSULTANT shall correct or revise, without additional cost to the owner, any defects, errors or deficiencies in CONSULTANT's performance under this Agreement.

III. THE CITY AGREES:

A. To furnish all available data pertaining to the PROJECT now in the City Engineer's Office.

B. To provide standards as required for the PROJECT.

C. To review the CONSULTANT's submittals of preliminary and final documents, to compile and coordinate the CITY"s resulting review comments, and to note or otherwise indicate to the CONSULTANT those comments or alternate revisions which are to be incorporated in the Final Revised Specifications.

D. To pay the CONSULTANT for his services in accordance with the requirements of this agreement.

IV. PAYMENT PROVISIONS

A. Payment to the CONSULTANT for the performance of the engineering services required by this agreement shall be based upon the CONSULTANT'S cost plus a fee for profit based upon a fixed percentage of the CONSULTANT'S cost. Payments shall be full compensation for payroll costs (but shall not include payroll costs paid at overtime rates), expenses, overhead, profit, subcontracting and all other costs required in performing the work described herein. The tests of the allowability to be applied for this agreement shall be based on the provisions of the agreement and on the reasonableness of allocation of costs under generally accepted accounting principles and practices.

Overhead costs shall be computed by multiplying an Overhead Factor times the actual salaries or wages paid to personnel assigned to the PROJECT. The Overhead Factor shall be 143.33 percent for the work required by this agreement. Payments for the CONSULTANT'S costs shall be based upon actual cost incured in providing the services and may be less than the estimated amount. Total payments to the CONSULTANT shall include the actual costs accruing in the performance of the engineering services as outlined in this agreement which are estimated to amount to $8,323.00, plus a fee for profit which shall be 15 percent of the CONSULTANT'S actual costs so that the total payments shall not exceed the sum of $9,564.00.

B. If additional work should be necessary, by virtue of a major change in the scope of the proposed PROJECT, the CONSULTANT will be given written notice by the CITY along with a request for an estimate of the actual costs plus a fee for profit based upon a fixed percentage of the CONSULTANT'S costs for performance of such additions; but no additional work shall be performed nor shall additional compensation be paid except on the basis of a Supplemental Agreement duly entered into by the parties.

V. THE PARTIES HERETO MUTUALLY AGREE:

A. That the right is reserved to the CITY to terminate this agreement at any time, upon written notice, in the event the PROJECT is to be abandoned or indefinitely postponed, or because of the CONSULTANT'S inability to proceed with the work, or because the services of the CONSULTANT are unsatisfactory; PROVIDED, however, that in any case the CONSULTANT shall be paid the reasonable value of the services rendered up to the time of termination on the basis of the provisions of this agreement, but in no case shall payment be more than the CONSULTANT'S actual costs plus a fee for profit based upon a fixed percentage of the CONSULTANT'S actual costs as provided in Article IV.

B. That the documents pertaining to the PROJECT shall become the property of the CITY upon completion or termination of the CONSULTANT'S services in accordance with this agreement; and there shall be no restriction or limitation on their further use by the CITY.

C. That the services to be performed by the CONSULTANT under the terms of this agreement are personal and cannot be assigned, sublet or transferred without specific consent of the CITY.

D. In the event of unavoidable delays in the progress of the work contemplated by this agreement, reasonable extensions in the time allotted for the work will be granted by the CITY, provided, however, that the CONSULTANT shall request extensions in writing giving the reasons therefor.

E. It is further agreed that this agreement and all contracts entered into under the provisions of this agreement shall be binding upon the parties hereto and their successors and assigns.

F. Neither the CITY'S review, approval or acceptance of, nor payment for, any of the work or services required to be performed by the CONSULTANT under this agreement shall be construed to operate as a waiver of any right under this agreement or any cause of action arising out of the performance of this agreement.

G. The rights and remedies of the CITY provided for under this agreement are in addition to any other rights and remedies provided by law.

H. It is specifically agreed between the parties executing this contract, that it is not intended by any of the provisions of any part of this contract to create the public or any member thereof a thirdparty beneficiary hereunder, or to authorize anyone not a party to this contract to maintain a suit for damage pursuant to the terms or provisions of this contract.

IN WITNESS WHEREOF, the CITY and the CONSULTANT have executed this agreement as of the date first written above.

CITY OF WICHITA

By: E. H. Denton
E. H. Denton, City Manager

ATTEST:

Donald C. Gisick, City Clerk

Approved as to Form:

John Dekker, Director of Law

WILSON & COMPANY
ENGINEERS & ARCHITECTS

By: Ronald L. Chandler
Ronald L. Chandler, Manager

ATTEST:

CAROL A. CHURCH
NOTARY PUBLIC
STATE OF KANSAS
MY APPT. EXPIRES 5/2/86

Carol A. Church
Secretary

June 24, 1983

David Stowe, Director, Operations/Maintenance

Robert A. Lakin, Director of Planning

Storm Sewer Pipe Task Force

Yesterday the Storm Sewer Pipe Committee (by consensus I suppose) concluded (including our own engineering staff) that the Wilson contract was inadequate to meet the City's need, and more particularly the Task Force's desires, as they interpret their report. There is 2,300 dollars left in the Wilson contract, less yesterday's time for Chandler and Osborne.

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Robert A. Lakin
Director of Planning

RAL:FN:rme

cc: Robert Finch, Deputy City Manager
Mike Lindebak, City Engineer
Forrest Nagley, Junior Planner, Current Plans Division
John Wynkoop, Director, Water and Water Pollution Control

bcc: George Wilton, 1909 Carson, 67216
James Gardner, II, Planning Commissioner

June 7, 1983

Task Force on Storm Sewer Pipe Materials

Forrest L. Nagley, Junior Planner

Forwarding of agenda for June 23rd meeting and a copy of the first draft of the reworded, "Installation Specifications for Sewers."

Attached is an agenda for the next meeting of the Task Force on Storm Sewer Pipe Materials. The meeting will begin at 4:00 p.m. in the Planning Department Conference Room, 10th Floor, City Hall. Also attached is a copy of the first draft of the changes proposed for the City's "Installation Specifications for Sewers." Review of the proposed changes is item one on the June 23rd agenda.

Should you have any questions, please call me at 268-4421.

Forrest L. Nagley
Junior Planner

FLN:bh

June 7, 1983

Interested Individuals and Organizations

Forrest L. Nagley, Junior Planner

Forwarding of agenda for June 23rd meeting of the Task Force on Storm Sewer Pipe Materials

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FLN:bh

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Robert Reinke, ARMCO, 900 N. Tyler, 67212
Robert Meinzer, ARMCO, 5900 S.W. 29th St., Topeka, Ks. 66614
Darwin L. Christensen, Kaiser Aluminum, Suite A-170 5278 Pinemont Drive, Murray, Utah, 84107

May 25, 1983

George,

Here's a copy of the proposed changes to the sewer installation specifications. I will get a proposed agenda out to you next week. The T.F. meeting is still tentatively scheduled for June 23rd. Once we agree on the agenda, I will send notification to T.F. members & the public. I have copies of the rewrite to give to each T.F. member. Perhaps Wilson & Co. should be ask to be present at the June meeting to address questions.

Tom

April 19, 1983

Task Force on Storm Sewer Pipe Materials

Forrest L. Nagley, Junior Planner

Forwarding of memorandums regarding Storm Sewer Pipe Study and proposed meeting date of the Task Force

Attached please find the following memorandums:

1. March 25, 1983 - Robert A. Lakin

2. April 4, 1983 - E. H. Denton

3. April 11, 1983 - R. W. Bruggeman

A tentative meeting date of the Task Force has been set for June 23, 1983, at 3:00 p.m., in the Planning Department Conference Room. If this meeting date presents a conflict for any of you, please call me at 268-4421.

Forrest L. Nagley
Junior Planner

FLN:bh

Attachments (3)

Forrest go ahead & set proje
Meeting Do not reschedule on
4-29, 28 or 29 w RB & Lindsl
one out of town

RS

4/14/83

THE CITY OF WICHITA

OFFICE OF Director of Engineering DATE April 11, 1983

RECEIVED
APR 12 1983
METROPOLITAN PLANNING
ROUTE ☐ _____
☐ _____

TO Robert A. Lakin, Director of Planning

FROM R. W. Bruggeman, Director of Engineering

SUBJECT Six-Month Review - Status of Stormwater Pipe Study Report

The following information is being submitted in response to the recommendations of the Task Force on Stormwater Pipe Materials:

Recommendation No. 1 - A letter dated December 9, 1982 from E. H. Denton to G. H. Wilton, copy attached, advised that the final inspection of storm sewer projects over 36" in diameter would be as follows:

(1) Final inspection will be accomplished by the engineering inspector assigned to the project, accompanied by a field engineer.

(2) In the event that the workload of the Department of Engineering prohibits a timely final inspection, a consulting engineer will be hired to do the final inspection.

Mr. Denton also advised as follows: "The Task Force may desire to comment on the procedure at the time it completes its six-month review of the experience under the new policy on storm water sewer materials."

Recommendation Nos. 2 and 11 - The Design Division of the Department of Engineering has been instructed through Paul Graves, Chief Engineer, to provide for a minimum cleansing velocity of 2 feet per second (fps) at a depth of 0.2 of the diameter or rise of the pipe in the design of all storm sewers designed by the Department of Engineering or by consultants for projects that are to be constructed in the City of Wichita or for which the City has jurisdiction and that the minimum allowable thickness for corrugated steel pipe is 0.019" or 12 gauge.

Recommendation No. 3 - A one-day (8 hours) class was conducted by Lawrence Schaller, Area Engineer, for sewer inspectors. The material covered was detail sheets, use of laser for line and grade, joint gap specifications and storm sewer bedding, backfill and compaction. A meeting of all sewer inspectors is held each two weeks for approximately one-half hour. Preliminary arrangements have been made in conjunction with the Kansas Chapter of the American Public Works Association for an advanced inspectors school to be held in Wichita in the Spring of 1984.

Recommendation Nos. 4, 5, 6, 7, 9, 12 and 15 - An engineering contract was entered into December 14, 1982 with the firm of Wilson & Company to update the technical specifications for sanitary and storm sewer construction. The contract provides that the consultant is to submit preliminary recommended revisions within 90 days after notice to proceed. The consultant's report shall include consideration of the City's Task Force on Stormwater Pipe Materials.

Recommendation No. 8 - Literature is being reviewed as it becomes available regarding materials, other than those currently in use by the City, for a test installation.

Recommendation No. 10 - City of Wichita, Kansas, Department of Engineering, Sanitary and Storm Sewers, Proposals and Specifications, revised March, 1982, page 18, reads as follows: "Corrugated metal pipe used in the construction of storm sewers and culverts shall be furnished with the 'hugger' band coupler as manufactured by Armco Steel Corporation, or an approved equal, for connecting sections of corrguated metal pipe." The inclusion of gaskets will be a part of the rewrite of specifications as contained in Recommendation Nos. 4, 5, etc.

Recommendation No. 13 - As of this date, no 12 gauge corrugated steel pipe or test installations have been constructed. We will develop a procedure for evaluation of these materials in conjunction with the Sewer Maintenance Division as soon as construction takes place.

Recommendation No. 14 - It is my recommendation that the task force be furnished a copy of the Wilson & Company report for their review prior to their reconvening. They could then make recommendations regarding this report at their meeting. A copy of the report will be furnished to you upon its receipt by the Department of Engineering. We anticipate receiving this report, which is overdue, by May 13, 1983.

Recommendation No. 16 - A committee of local consulting engineers is preparing drainage criteria that will be presented to the City Commission for their adoption that will contain the Manning's Friction Factors (n) as shown in the appendix to the "Cost Effectiveness Study on Storm Sewer Pipe Materials."

Please advise when the task force is to meet and I and other members of the Department of Engineering will be available as requested.

R. W. Bruggeman
Director of Engineering

RWB:gr

Attachment

cc: E. H. Denton, City Manager

THE CITY OF WICHITA

OFFICE OF THE CITY MANAGER
CITY HALL — THIRTEENTH FLOOR
455 NORTH MAIN STREET
WICHITA, KANSAS 67202
(316) 268-4351

December 9, 1982

Mr. George Wilton
Chairman, Task Force on Cost-Effectiveness
Study of Sewer Pipe Materials
1909 Carson
Wichita, Kansas 67216

Dear George:

Your response of November 23, 1982, to my letter of November 3, 1982, regarding final inspection of storm sewer projects over 36" is appreciated. I concur that a final inspection of such projects is needed.

There is merit in your suggestion that Sewer Maintenance perform the final inspection, however following discussions with the Director of Water and the Director of Engineering it has been concluded that the most effective way to provide the final inspection would be as follows:

1) Final inspection will be accomplished by the Engineering Inspector assigned to the project, accompanied by a Field Engineer.

2) In the event that the workload of the Department of Engineering prohibits a timely final inspection, a consulting engineer will be hired to do the final inspection.

It is felt that this procedure will provide continuity in the inspection process by having the same inspector that does the daily inspections participate in the final, and will be less costly than the hiring of a full-time trained inspector in the maintenance division to perform the job.

RWB

THE CITY OF WICHITA

Mr. George Wilton
December 9, 1982

The Task Force may desire to comment on the procedure at the time it completes its six-month review of the experience under the new policy on storm water sewer materials.

You and the Task Force members' advice in this matter is greatly appreciated.

Sincerely,

E. H. Denton
City Manager

EHD:fmp
cc: The Honorable Board of City Commissioners
John Wynkoop, Director of Water and Water Pollution Control
Ray W. Bruggeman, Director of Engineering
Robert A. Lakin, Director of Planning
Don E. Anderson, Director of Housing and Economic Development
Jim Gardner, Chairman, Metropolitan Area Planning Commission
Joel Pollack, Chairman, Economic Development Commission

THE CITY OF WICHITA

OFFICE OF CITY MANAGER

DATE April 4, 1983

TO R. W. Bruggeman, Director of Engineering

FROM E. H. Denton, City Manager

SUBJECT Six-Month Review -- Status of Stormwater Pipe Study Report

You have received a copy of the memorandum from the Director of Planning on the captioned subject.

Please prepare the requested status report and provide your full cooperation to the progress review. You should provide this office with a copy of the status report as well as Planning.

E. H. Denton
City Manager

EHD/tpd
cc: Robert A. Lakin, Director of Planning

February 8, 1983

Chris Breitenstein, Drainage Engineer,
City Engineering

Forrest L. Nagley, Junior Planner

Forwarding of extra copies of Storm Sewer Pipe Report

Attached please find three extra copies of the Storm Sewer Pipe Report. I thought you might need these in case you get a request for a copy.

Forrest L. Nagley
Junior Planner

FLN:bh

Attach.

December 15, 1982

Task Force on Storm Sewer Pipe Materials

Forrest L. Nagley, Junior Planner

Forwarding of letters regarding Cost Effectiveness Study on Storm Sewer Pipe Materials

Attached please find the following letters:

1. December 8, 1982 - Robert G. Finch.

2. December 9, 1982 - E. H. Denton.

Forrest L. Nagley
Junior Planner

FLN:bh

THE CITY OF WICHITA

OFFICE OF CITY MANAGER DATE December 8, 1982

TO Ray W. Bruggeman, Director of Engineering

FROM Robert G. Finch, Deputy City Manager

SUBJECT Final Inspection of Over 36" Storm Sewer Projects

Pursuant to our meeting of December 8, 1982, please initiate a final inspection procedure on storm sewer projects using over 36" pipe as follows:

1) Final inspection will be accomplished by the Engineering Inspector assigned to the project, accompanied by a Field Engineer.

2) In the event that the workload of the Department of Engineering prohibits a timely final inspection, the final inspection will be accomplished by a consulting engineer hired under the provisions of AR 7.

Robert G. Finch
Deputy City Manager

RGF:mp
cc: John Wynkoop, Director of Water and Water Pollution Control
George Wilton

THE CITY OF WICHITA

OFFICE OF THE CITY MANAGER
CITY HALL — THIRTEENTH FLOOR
455 NORTH MAIN STREET
WICHITA, KANSAS 67202
(316) 268-4351

December 9, 1982

Mr. George Wilton
Chairman, Task Force on Cost-Effectiveness
Study of Sewer Pipe Materials
1909 Carson
Wichita, Kansas 67216

Dear George:

Your response of November 23, 1982, to my letter of November 3, 1982, regarding final inspection of storm sewer projects over 36" is appreciated. I concur that a final inspection of such projects is needed.

There is merit in your suggestion that Sewer Maintenance perform the final inspection, however following discussions with the Director of Water and the Director of Engineering it has been concluded that the most effective way to provide the final inspection would be as follows:

1) Final inspection will be accomplished by the Engineering Inspector assigned to the project, accompanied by a Field Engineer.

2) In the event that the workload of the Department of Engineering prohibits a timely final inspection, a consulting engineer will be hired to do the final inspection.

It is felt that this procedure will provide continuity in the inspection process by having the same inspector that does the daily inspections participate in the final, and will be less costly than the hiring of a full-time trained inspector in the maintenance division to perform the job.

THE CITY OF WICHITA

Mr. George Wilton
December 9, 1982

The Task Force may desire to comment on the procedure at the time it completes its six-month review of the experience under the new policy on storm water sewer materials.

You and the Task Force members' advice in this matter is greatly appreciated.

Sincerely,

E. H. Denton
City Manager

EHD:fmp
cc: The Honorable Board of City Commissioners
John Wynkoop, Director of Water and Water Pollution Control
Ray W. Bruggeman, Director of Engineering
Robert A. Lakin, Director of Planning
Don E. Anderson, Director of Housing and Economic Development
Jim Gardner, Chairman, Metropolitan Area Planning Commission
Joel Pollack, Chairman, Economic Development Commission

DISTRIBUTION TO DESIGN ENGINEERS

1. KEN BENGSTON – Mid-KANSAS Engineering Cons.
2. RON CHANDLER – WILSON AND CO. MAILED 12/10
3. C. GOODNESS – REISS & GOODNESS – given to ART GRIFFITH
4. DON MOENRING – MOENRING & ASSOC. – given to MOENRING
5. BOOKER / FREUND – MAILED 12/10
6. Brent Worten – BAUGHMAN CO. – given to Bill Korber
7. BRUCE BAUGH – VAN DOREN, HAZARD, Stallings – given to Steve ANDERSON
8. Campbell & Castle – MAILED 12/10
9. RON Pletcher – P.E.C., P.A. – given to DICK CANN.
10. POE AND ASSOCIATES – MAILED 12/10

- ✓PEC - Ron Pletcher
- ✓WOH&S
- ✓Bengtson
- ✓Bax & Assoc.
- ✓Reiss & Goodness
- ✓Keeling
- ✓Custom & Co. - Ron Chandler
- ✓Baxter Freund - Wilmer Freund
- ✓Campbell & Cattle
- Mid-Kansas Engineering Consultants
  Ken Bengston

. Send Pipe Committee Reports to the above.

November 30, 1982

Task Force on Storm Sewer Pipe Materials

Forrest L. Nagley, Junior Planner

Forwarding of letters regarding Cost Effectiveness Study on Storm Sewer Pipe Materials.

Attached please find the following letters:

1. November 3, 1982 - E. H. Denton
2. November 23, 1982 - George Wilton

Forrest L. Nagley
Junior Planner

FLN:bh

Attach.

Copies of George's letter to Denton also sent to Pollack & Gardner.

THE CITY OF WICHITA

OFFICE OF THE CITY MANAGER
CITY HALL – THIRTEENTH FLOOR
455 NORTH MAIN STREET
WICHITA, KANSAS 67202
(316) 268-4351

November 3, 1982

Mr. George Wilton
Chairman, Task Force on Cost-Effectiveness
Study of Sewer Pipe Materials
1909 Carson
Wichita, KS 67216

Dear George:

The recommendations of the subject Task Force, the Metropolitan Area Planning Commission and the Economic Development Commission pertaining to sewer pipe materials are now being placed into effect by the City.

One of the recommendations of the Task Force was to have the Sewer Maintenance Division perform inspections on newly installed storm sewers.

Sewer Maintenance has already begun inspecting 36" and smaller sized pipe with its TV units. Storm pipe larger than this is inspected internally and approved, usually on a daily basis, by the engineer or pipe inspector on the project; however, this individual is an employee of the Engineering Department rather than Water and Water Pollution Control.

The City believes this is an effective means of receiving quality workmanship and proposes to continue this procedure unless it is felt that it does violence to the recommendations of the Task Force, Metropolitan Area Planning Commission and Economic Development Commission.

We will continue to use this procedure for inspections unless we hear to the contrary from you or other recipients of this letter.

Sincerely,

E. H. Denton
City Manager

EHD/fpd George: Thanks for your work on the task force. EHD

November 23, 1982

Mr. E. H. Denton, City Manager
City of Wichita
455 N. Main, 13th Floor
Wichita, Kansas 67202

Re: Cost Effectiveness Study on Storm Sewer Pipe Materials

Dear Gene:

Reference is made to your letter of November 3, 1982, regarding placing into effect the recommendations of the Task Force on Storm Sewer Pipe Materials, the Metropolitan Area Planning Commission and the Economic Development Commission. I was alarmed to learn that Recommendation Number 1, to have a final check of the completed project by maintenance personnel prior to acceptance, was to be followed in part only. What your letter proposes for the lines larger than 36" in diameter is, of course, the procedure which has supposedly been followed for years. The Task Force was presented with sufficient data to convince most members that past procedures had not been successful. The Task Force concluded that many of the problems discovered while examining various storm sewer installations could have been averted or corrected at the contractor's cost by more stringent enforcement of the contract documents.

My experience with sanitary sewers during the twenty years the maintenance of sanitary sewers was part of my responsibility convinced me that the only way to insure a completed installation free of expensive, trouble-causing defects was to have those people who would have to live with the installation make a pre-maintenance or pre-acceptance inspection. We tried for many years to get improvements in sanitary sewer installations by informing the engineers of the defects in the lines we discovered the hard way, but very little, if anything, was ever done to prevent a recurrence. When the program of a final check for defects by maintenance forces began there was a rapid improvement.

As I stated above, the Task Force was presented with data which convinced most of the members that a pre-maintenance check by maintenance personnel was necessary. The data presented was in the form of photographs and television tapes which I will be happy to show you, if you so desire. Briefly, however, they show unplugged lift holes and unwiped joints in the concrete lines. For corrugated steel pipe, such defects as concrete leakage at manholes, excessive gaps at joints, backfill material leaking through joints, damaged or missing paving material, pipe deflection, damaged pipe from installation or backfill, improperly seated bands leaving a gap at joint, and two different sizes of pipe used between adjacent manholes were found.

In view of the foregoing, I do not believe that "business as usual" for lines larger than 36" will be acceptable to the Task Force. It is requested that you reconsider your decision.

Respectfully submitted,

George Wilton

George Wilton, Chairman
Task Force on Storm Sewer Pipe Materials

cc: Task Force Members

November 10, 1982

DR 82-23 File - Cost Effectiveness Study of Storm Sewer Pipe Materials

Forrest L. Nagley, Junior Planner

Printing of the Storm Sewer Pipe Report

On Tuesday, November 9, 1982, I forwarded the completed Storm Sewer Pipe Report to Gary Pierce for printing. We are proceeding with printing option #1, as outlined in my October 25, 1982 memo to Lakin.

Printing costs are projected to be $308.20. A breakdown of anticipated costs are provided in the October 25th memo. Sixty copies of the document will be printed.

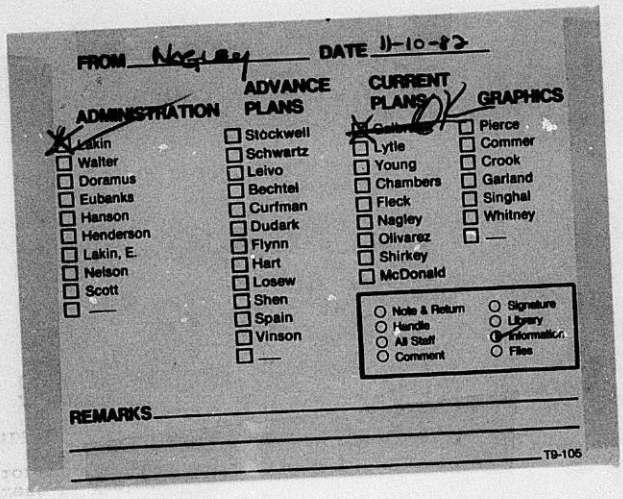
The final report will be printed on both sides of the page. A lime green cover has been selected with a matching green "vello-bind" binder. Sixty copies of the "conduit sizing chart" will be made after the printed document is back from printing.

Distribution of the report is planned for early to mid-December.

Forrest L. Nagley
Junior Planner

FLN:bh

cc: Jack Galbraith, Chief Planner
Gary Pierce, Graphics supervisor



FROM Nagley DATE 11-10-82

ADMINISTRATION	ADVANCE PLANS	CURRENT PLANS	GRAPHICS
☒ Lakin	☐ Stockwell	☒ [illegible]	☐ Pierce
☐ Walter	☐ Schwartz	☐ Lytle	☐ Commer
☐ Doramus	☐ Leivo	☐ Young	☐ Crook
☐ Eubanks	☐ Bechtel	☐ Chambers	☐ Garland
☐ Hanson	☐ Curfman	☐ Fleck	☐ Singhal
☐ Henderson	☐ Dudark	☐ Nagley	☐ Whitney
☐ Lakin, E.	☐ Flynn	☐ Olivarez	☐ —
☐ Nelson	☐ Hart	☐ Shirkey	
☐ Scott	☐ Losew	☐ McDonald	
☐ —	☐ Shen		
	☐ Spain		
	☐ Vinson		
	☐ —		

○ Note & Return	○ Signature
○ Handle	○ Library
○ All Staff	○ Information
○ Comment	○ Files

REMARKS _____

T9-105

THE CITY OF WICHITA

OFFICE OF THE CITY MANAGER
City Hall, 7th Floor
455 North Main Street
Wichita, Kansas 67202
(316) 268-4331

November 3, 1982

Mr. George Wilton
Chairman, Task Force on Cost-Effectiveness
Study of Sewer Pipe Materials
1909 Carson
Wichita, KS 67216

Dear George:

The recommendations of the subject Task Force, the Metropolitan Area Planning Commission and the Economic Development Commission pertaining to sewer pipe materials are now being placed into effect by the City.

One of the recommendations of the Task Force was to have the Sewer Maintenance Division perform inspections on newly installed storm sewers.

Sewer Maintenance has already begun inspecting 36" and smaller sized pipe with its TV units. Storm pipe larger than this is inspected internally and approved, usually on a daily basis, by the engineer or pipe inspector on the project; however, this individual is an employee of the Engineering Department rather than Water and Water Pollution Control.

The City believes this is an effective means of receiving quality workmanship and proposes to continue this procedure unless it is felt that it does violence to the recommendations of the Task Force, Metropolitan Area Planning Commission and Economic Development Commission.

We will continue to use this procedure for inspections unless we hear to the contrary from you or other recipients of this letter.

Sincerely,

E. H. Denton
City Manager

EHD/fpd George: Thanks for your work on the task force EHD

WICHITA

Mr. George Wilton
November 3, 1982

cc: Jim Gardner, Chairman, Metropolitan Area Planning Commission
Joel Pollack, Chairman, Economic Development Commission
The Honorable Board of City Commissioners
John Wynkoop, Director of Water and Water Pollution Control
R. W. Bruggeman, Director of Engineering
Robert A. Lakin, Director of Planning
Don E. Anderson, Director of Housing and Economic Development

October 27, 1982

Task Force on Storm Sewer Pipe Materials

Forrest L. Nagley, Junior Planner

Forwarding of information from City Engineering regarding the Storm Sewer Pipe Materials Report.

Attached please find a copy of a memorandum prepared by the Department of Engineering concerning storm sewer pipe specifications. In effect, the memorandum provides a list of those projects for which the new criteria, proposed in the Task Force's Report, will not be applied.

Forrest L. Nagley
Junior Planner

FLN:bh

Attachment

provided copy of the foregoing memo / attachment to Don Gibbs, Millcon Corporation on 11/2/82 FLN

THE CITY OF WICHITA

OFFICE OF Department of Engineering **DATE** October 25, 1982

TO Robert G. Finch, Deputy City Manager

FROM R. W. Bruggeman, Director of Engineering/City Engineer

SUBJECT Storm Sewer Pipe Specifications

The following information is in response to your October 15, 1982 memo for information requested by Mr. Gibbs. The information is also being forwarded to Robert A. Lakin by copy of this memo for distribution to members of the Professional Engineering Task Force on Storm Sewer Pipe.

New specifications will apply to all storm water sewer projects approved by the City Commission after October 12, 1982. The following projects are projects approved prior to October 12, 1982 for which the new specifications will not apply. Projects currently inactive are noted "Hold for Development". "Design in Progress" indicates a project with complete or partially complete plans but not under contract.

PROJECT NUMBER	PROJECT DESCRIPTION	HOLD FOR DEVELOPMENT	DESIGN IN PROGRESS
468 76 245 80450 1	STORM WATER SEWER NO. 127	X	
468 76 245 80725 1	STORM WATER SEWER NO. 156	X	
468 76 245 80737 1	STORM WATER SEWER NO. 158	X	
468 76 245 80756 1	STORM WATER SEWER NO. 160	X	
468 76 245 80826 1	STORM WATER SEWER NO. 169	X	
468 76 245 80852 1	STORM WATER SEWER NO. 171	X	
468 76 245 80916 1	STORM WATER SEWER NO. 181	X	
468 76 245 80917 1	STORM WATER SEWER NO. 182	X	
468 76 245 80936 1	STORM WATER SEWER NO. 186	X	
468 76 245 80937 1	STORM WATER SEWER NO. 188	X	
468 76 245 80938 1	STORM WATER SEWER NO. 185		X
468 76 245 80958 1	STORM WATER SEWER NO. 192	X	
468 76 245 80969 1	STORM WATER SEWER NO. 195	X	
468 76 245 80984 1	STORM WATER SEWER NO. 198	X	
468 76 245 80990 1	STORM WATER SEWER NO. 201	X	
468 76 245 80992 1	STORM WATER SEWER NO. 200	X	
468 76 245 81035 1	STORM WATER SEWER NO. 210		X
468 76 245 81036 1	STORM WATER SEWER NO. 211	X	
468 76 245 81037 1	STORM WATER SEWER NO. 212	X	
468 76 245 81038 1	STORM WATER DRAIN NO. 48		X
468 76 245 81050 1	STORM WATER SEWER NO. 218	X	
468 76 245 81059 1	STORM WATER SEWER NO. 220	X	
468 76 245 81060 1	STORM WATER SEWER NO. 221	X	
468 76 245 81066 1	STORM WATER SEWER NO. 222	X	
468 76 245 81067 1	STORM WATER SEWER NO. 223	X	
468 76 245 81068 1	STORM WATER SEWER NO. 224	X	
468 76 245 81078 1	STORM WATER SEWER NO. 226	X	

PROJECT NUMBER	PROJECT DESCRIPTION	HOLD FOR DEVELOPMENT	DESIGN IN PROGRESS
468 76 245 81082 7	STORM WATER SEWER NO. 232		X
468 76 245 81103 1	MAPLE AND I-235 FLOODWAY PUMPING STATION REVISION		X
468 76 245 81113 1	STORM WATER SEWER NO. 230	X	
468 76 245 81114 1	STORM WATER SEWER NO. 231	X	
468 76 245 81116 1	MAIN STORM WATER DRAIN # 50		X
468 76 245 81134 1	FLOODWATER DETENTION RESERVOIR NO. 14	X	
468 76 245 81144 1	FLOODWATER DETENTION RESERVOIR NO. 16	X	
468 76 245 81154 1	DETENTION RESERVOIR NO. 17	X	
468 76 245 81166 1	STORM WATER SEWER NO. 236	X	
468 76 245 81171 1	STORM WATER SEWER NO. 240	X	
468 76 245 81172 1	STORM WATER SEWER NO. 239	X	
468 76 245 81173 1	STORM WATER SEWER NO. 241	X	
468 76 245 81174 1	STORM WATER DRAIN NO. 52	X	
468 76 245 81175 1	STORM WATER DRAIN NO. 53	X	
468 76 245 81177 1	STORM WATER SEWER NO. 238	X	
468 76 245 81198 1	STORM WATER SEWER NO. 243	X	
468 76 245 81205 1	STORM WATER SEWER NO. 244	X	
468 76 245 81213 1	DETENTION RESERVOIR NO. 18	X	
468 76 245 81224 1	STORM WATER DRAIN NO. 54	X	

The new specifications will not apply to drainage in connection with the following street projects:

1.) Amidon - 29th to 35th Street North
2.) Central - Mead to Ohio
3.) Central - Ohio to Pennsylvania
4.) Central - Crestline to Milstead
5.) Kellogg and Webb
6.) McLean - Douglas to 2nd
7.) Murdock - Wabash to I-135
8.) 29th Street North - Rock to Webb
9.) Rock Road - Central to City Limits
10.) Woodlawn - Rockhill to 30th Street North
11.) 37th Street North - Broadway to Hydraulic

R. W. Bruggeman
Director of Engineering/City Engineer

RWB:ML:ck

cc: Robert A. Lakin, Director of Planning

CITY OF WICHITA STAFF MEMBERS

Darrell R. Brewer, Jr., Superintendent of Sewer Maintenance
R. W. Bruggeman, P.E., Director of Engineering
Steve Lackey, P.E., Construction Engineer
Robert A. Lakin, Director of Planning
John D. Wynkoop, Director of Water & Water Pollution Control

The Task Force also wishes to thank the following organizations or firms for providing product information and representatives at meetings.

J and J Metal Products
National Corrugated Steel Pipe Association
J and J Drainage Products

COMMISSION REVIEW OF THE REPORT

Metropolitan Area Planning Commission
September 9, 1982

Economic Development Commission
September 23, 1982

Wichita Board of City Commissioners
October 12, 1982

FROM Nagley DATE 11/8/82

ADMINISTRATION	ADVANCE PLANS	CURRENT PLANS	GRAPHICS
☑ Askin	☐ Stockwell	☐ Galbraith	☐ Pierce
☐ Walter	☐ Schwartz	☐ Lytle	☐ Commer
☐ Doramus	☐ Leivo	☐ Young	☐ Crook
☐ Eubanks	☐ Bechtel	☐ Chambers	☐ Garland
☐ Hanson	☐ Curfman	☐ Fleck	☐ Singhal
☐ Henderson	☐ Dudark	☐ Nagley	☐ Whitney
☐ Lakin, E.	☐ Flynn	☐ Olivarez	☐ —
☐ Nelson	☐ Hart	☐ Shirkey	
☐ Scott	☐ Losew	☐ McDonald	
☐ —	☐ Shen		
	☐ Spain		
	☐ Vinson		
	☐ —		

○ Note & Return	○ Signature
○ Handle	○ Library
○ All Staff	○ Information
① Comment	○ Files

REMARKS Here's how George and I propose to handle the acknowledgement problem on the Storm Sewer Pipe Rpt. Fergat

T9-105

October 25, 1982

Robert A. Lakin, Director of Planning

Forrest L. Nagley, Junior Planner

Printing of Storm Sewer Pipe Report (DR 82-23)

I have talked with Gary Pierce about costs associated with printing the Storm Sewer Pipe Report. We have identified the following choices:

CHOICE #1 (Reprint of entire report)

1.	Printing	$ 180.00 @ 60 copies/ 45 pages
2.	Photographs	$ 53.20 @ 12 photos on 10 pages
3.	Front and back cover (no artwork)	$ 20.00
4.	Binding (vello-bind)	$ 33.00 -27
5.	"Conduit sizing" insert (blue line print with no pocket)	$ 22.00 -18
		+
		$ 308.20

CHOICE #2 (Reprint of entire report)

1.	Printing	$ 188.00 @ 60 copies/ 47 pages
2.	Photographs	$ 10.60 grouped and reduced on 2 pages
3.	Front and back cover	$ 20.00
4.	Binding	$ 33.00
5.	"Conduit Sizing" insert	$ 22.00
		+
		$ 273.60

FROM 7Lm **DATE** 10-25-82

ADMINISTRATION	ADVANCE PLANS	CURRENT PLANS	GRAPHICS
☒ ~~Lakin~~	☐ Stockwell	[redacted]	☐ Pierce
☐ Walter	☐ Funk	☐ Lytle	☐ Stafford
☐ Doramus	☐ Leivo	☐ Young	☐ Commer
☐ Eubanks	☐ Bechtel	☐ Chambers	☐ Crook
☐ Hanson	☐ Curfman	☐ Fleck	☐ Garland
☐ Henderson	☐ Dudark	☒ ~~Nagley~~	☐ Singhal
☐ Holdeman	☐ Flynn	☐ Olivarez	☐ Whitney
☐ Lakin, E.	☐ Haas	☐ Shirkey	☐ —
☐ Nelson	☐ Hart		
☐ Scott	☐ Losew		
	☐ Shen		
	☐ Spain		
	☐ Vinson		
	☐ —		

○ Note & Return ○ Handle ○ All Staff ● Comment ○ Signature ○ Library ○ Information ○ Files

REMARKS If photos "real", option 2. If not option #1. Work w/Walter + how to handle names of those who did not want identified. I assume leave them off the general listing, but add a ¶ saying they were ~~there~~ there but have disclaimers at the rest of contents. Advise me how you propose to handle

T9-105

FROM 7Lm **DATE** 10-25-82

ADMINISTRATION	ADVANCE PLANS	CURRENT PLANS	GRAPHICS
☐ Lakin	☐ Stockwell	[redacted]	☐ Pierce
☐ Walter	☐ Funk	☐ Lytle	☐ Stafford
☐ Doramus	☐ Leivo	☐ Young	☐ Commer
☐ Eubanks	☐ Bechtel	☐ Chambers	☐ Crook
☐ Hanson	☐ Curfman	☐ Fleck	☐ Garland
☐ Henderson	☐ Dudark	☐ Nagley	☐ Singhal
☐ Holdeman	☐ Flynn	☐ Olivarez	☐ Whitney
☐ Lakin, E.	☐ Haas	☐ Shirkey	☐ —
☐ Nelson	☐ Hart		
☐ Scott	☐ Losew		
	☐ Shen		
	☐ Spain		
	☐ Vinson		
	☐ —		

○ Note & Return ○ Handle ○ All Staff ○ Comment ○ Signature ○ Library ● Information ○ Files

REMARKS I agree with #1 if we have minimum accuracy for Preentry - Keep me advised of other area problems.

T9-105

CHOICE #3 (Reprint of entire report)

1.	Printing	$ 196.00	@ 60 copies/ 49 pages
2.	Photographs	$ 0	@ no photographs
3.	Front and back cover	$ 20.00	
4.	Binding	$ 33.00	
5.	"Conduit Sizing" insert	$ 22.00	
		+	
		$ 271.00	

CHOICE #4 (Involves page inserts for existing printed report. We have 12 copies left).

1.	Printing		Xerox 30 copies of perhaps 8 retyped pages
2.	Photographs	$ 53.20	@ 12 photos on 10 pages
3.	Front and back cover	$ 0	
4.	Binding	$ 0	
5.	"Conduit sizing insert"	$ 22.00	
		$ 75.00	

For Choices 1 through 3, I plan the following distribution of the 60 copies of the report:

1.	Task Force	10
2.	D.R. File	1
3.	City Staff (Bruggeman, Brewer, Wynkoop)	3
4.	County Staff (Shelor and Hahn)	2
5.	Gardner and Flory	2
6.	Extra for Engineering	5
7.	Extra for Water	5
8.	Extra for Planning	13
9.	Consulting Engineers (P.E.C., (Baughman, Booker/Freund, etc.)	8
10.	Pipe Suppliers and persons in Acknowledgement	11
		60

For Choice #4, the replacement inserts would be provided to those persons who presently have a copy of the report (less Planning, Economic Development and City Commissioners). There would be no extra copies provided to City Engineering or the Water Department. We have 12 remaining copies of the report. There would be no copies available, except for our 12 copies, for distribution to consulting engineers who do not already have a copy of the report.

Please let me know which of the above choices you prefer or if you need additional information.

Forrest L. Nagley
Junior Planner

FLN:bh

cc: Jack Galbraith, Chief Planner
Gary Pierce, Graphics Supervisor

October 14, 1982

Task Force on Storm Sewer Pipe Materials

Forrest L. Nagley, Junior Planner

Cost-Effective Study on Storm Sewer Pipe Materials

On Tuesday, October 12, 1982, the Wichita Board of City Commissioners considered the above-referenced document. The action of the Commission was to approve the study of the Task Force, including the following specific provisions:

1. That administrative staff is directed to proceed immediately with implementation of the report recommendations;

2. That, after a period of six months, the Task Force be reconvened to review the progress made toward implemention of the recommendations;

3. That a professional consultant be hired to rewrite the City's installation specifications, including a separation of the requirements for rigid and flexible pipes.

Regarding number one of the above, it was stated that "immediately" shall be interpreted to apply to all new projects and shall not be interpreted to apply retroactively to projects which have been initiated.

Forrest L. Nagley
Junior Planner

FLN:bh

cc: R. W. Bruggeman, P. E., Director of Engineering
Darwin L. Christensen, P. E., Kaiser Aluminum
Donald E. Doerhoefer, Spiral Engineered Systems
Clinton Dunn, P. E., J and J Metal Products
Merl D. Francis, Big R Manufacturing and Distributing, Inc.
Don Gibbs, Millcon Corporation
Robert L. Meinzer, P. E., ARMCO, Inc.
Tom Nearn, P. E., Kaiser Aluminum
Bob Reinke, ARMCO, Inc.
Mike Rice, J and J Metal Products, Inc.
Thomas E. Selders, Big R Manufacturing and Distributing, Inc.
John Wesselhoff, P. E., National Corrugated Steel Pipe Association

John Wynkopp, Director, Department of Water and Water Pollution Control
Darrell R. Brewer, Jr., Superintendent of Sewer Maintenance
Don E. Anderson, Director, Department of Housing and Economic Development
James L. Gardner, II, Metropolitan Area Planning Commission
Joel Pollack, Chairman, Economic Development Commission
Phil Dietrich, Senior Civil Engineer, Sedgwick County Department of Public Works
Douglas Hahn, Ph.D., Sedgwick County Department of Environmental Resources
Dave Flory, Wichita, Kansas

October 14, 1982

Interested Individuals and Organizations

Forrest L. Nagley, Junior Planner

Cost-Effectiveness Study on Storm Sewer Pipe Materials

On Tuesday, October 12, 1982, the Wichita Board of City Commissioners considered the above-referenced document. The action of the Commission was to approve the study of the Task Force, including the following specific provisions:

1. That administrative staff is directed to proceed immediately with implementation of the report recommendations;

2. That, after a period of six months, the Task Force be reconvened to review the progress made toward implemention of the recommendations;

3. That a professional consultant be hired to rewrite the City's installation specifications, including a separation of the requirements for rigid and flexible pipes.

Regarding number one of the above, it was stated that "immediately" shall be interpreted to apply to all new projects and shall not be interpreted to apply retroactively to projects which have been initiated.

Forrest L. Nagley
Junior Planner

FLN:bh

cc: Tracy Burton, Wichita, Kansas
Stephen Clark, Clark Realtors
Anita Frey, Frey Realtors
Tom Ritchie, Ritchie Paving
Larry Martin, Mid-Kansas Construction, Inc.
George Tomlin, Major, Inc.
Lowell Richardson, Mid-Kansas Federal Savings and Loan
David Stowe, Director, Operations and Maintenance
Karl Kennedy, Industrial Development
Russell Brenner, Director of Administration
John Dekker, Law Department
William Rustin, County Counselor
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Wichita Metropolitan Area Board of Realtors, Inc.
Wichita Area Builders Association
Earl T. Graves, Wheeler, Kelly, Hagney Company, Inc.
Sedgwick County Public Information Office
City of Wichita Public Information Office
Citizens Participation Organization

October 14, 1982

Consulting Engineers

Forrest L. Nagley, Junior Planner

Cost-Effectiveness Study on Storm Sewer Pipe Materials

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Junior Planner

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cc: Ken Bengston, P. E., Van Doren-Hazard-Stallings
R. Chandler, P. E., Wilson and Company
C. Goodness, P. E., Reiss and Goodness
Don Moehring, P. E., Moehring and Associates
W. Freund, P. E., Booker and Freund Associates
O. Daniels, P. E., Engineering Test Company
Bob Friesen, P. E., The Law Company
F. Roedell, P. E., B. E. and C. Engineers
D. Winfrey, P. E., Winfrey Engineering Services
Brent Wooten, P. E., Baughman Company, P. A.
William Keltner, P. E., Allied Laboratories

The staff recommended three training period categories -- 4 to 9 weeks; 10 to 14 weeks; and 15 to 20 weeks.

The Council recommended one category of 4 to 10 weeks.

Reports were provided explaining the recommendations. All the recommendations are legal and acceptable under the federal guidelines.

In the past the City Commission policy has been to target the "most in need" and serve the clientele whenever possible. The staff recommendations align with that Commission policy. The PIC recommendations tend to broaden the past Commission policy and serve a wider range of clientele.

Should the Commission desire to broaden its past policy and serve a wider range of clientele, the PIC recommendations should be accepted. Should the Commision desire to retain its past policy and target the "poorest of the poor," the matter should be referred back to PIC for reconsideration.

E. H. Dentom — The City Manager reviewed this matter with the Commission and stated that staff will continue its efforts, in accordance with the Commission's direction, to try to provide a comprehensive program to break the cycle of poverty for those persons who have been out of work the longest or have the fewest skills, and he felt it could be done within the guidelines. He answered questions by the Commission.

Mayor Kirk — Mayor Kirk inquired if anyone present wished to speak and no one appeared.

Comm. Wright — Discussion was had and Commissioner Wright stated that she would reluctantly support the PIC recommendations as she questioned whether the poorest of the poor would be given the best opportunity for the longest possible training.

Motion -- -- carried — Brown moved that the City Commission concur with the PIC recommendation. Motion carried 5 to 0.

Recess — The Commission recessed at 10:43 a.m. and reconvened at 10:50 a.m.

REPORT ON COST-EFFECTIVENESS OF SEWER PIPE MATERIAL

REPORT ON COST-EFFECTIVENESS STUDY OF SEWER PIPE MATERIALS, presented.

In December, 1981, due to differences of opinion concerning relative merits of various storm sewer pipe materials, the City Commission directed the Metropolitan Area Planning Commission (MAPC) to proceed with a study of different storm sewer pipe materials. A task force comprised of the following persons was then appointed by the Chairman of the Planning Commission:

1) George Wilton (Chairman)
2) Chris Breitenstein, Drainage Engineer, City of Wichita
3) Charles Freund, Professional Engineering Consultants, P.A.
4) Max Hubbell, Campbell and Castle, Engineers, P.A.
5) M. S. Mitchell, Private Consultant
6) Bill Otten, Chief Water Engineer, City of Wichita
7) I. L. Penner, Private Consultant
8) Don Schneider, Sanitary Sewer Engineer, City of Wichita
9) Mike Thompson, Poe and Associates, P.A.

Seven open meetings were held with public notice provided. At those meetings different material suppliers were given the opportunity to express their view and make information available to the task force.

The task force report, unanimously approved by both the MAPC and the Economic Development Commission, contains the following recommendations:

--A recommendation for hydraulic "N" valves which more correctly reflect flow conditions in the field.

--A recommendation that the minimum allowable thickness of corrugated steel pipe be established at 0.109 inches or 12 guage in order to increase its predicted service life.

--A recommendation that smooth bituminous coatings and pavings in corrugated steel pipe no longer be permitted because of insufficient durability.

--A recommendation that the City of Wichita's installation specifications for storm and sanitary sewer be rewritten in order to be more clear and less open-ended.

--A recommendation that storm sewer pipe materials currently not being used by the City be specified for test installations.

During the Planning Commission and Economic Development Commission discussions, three additional specific recommendations were approved:

1) That the City Commission direct administrative staff to proceed immediately with implementation of the report recommendations.

2) That, after a period of six months, the task force be reconvened to review that progress made toward implementation of the recommendations.

3) That a professional consultant be hired to rewrite the City's installation specifications, including a separation of the requirement for rigid and flexible pipes.

Letters from manufacturers of corrugated steel pipe who object to the conclusions and recommendations of the report were provided.

It was recommended that the Commission concur with the recommendations of the Planning and Economic Development Commissions to include the three specific recommendations outlined above.

Representatives of the MAPC and Economic Development Commission and administrative staff were available to make the presentation and respond to questions.

E. H. Denton — The City Manager reviewed this matter with the Commission and stated that the Chairperson of the task force was present and would make a presentation in support of the recommendations outlined on the agenda.

George Wilton — George Wilton, Task Force Chairman, reviewed the report and the results of the study of the various pipe materials resulting in the recommendations made. He answered questions by the Commission

Don Gibbs — Don Gibbs, Milcon Corporation, spoke and urged the Commission to adopt the recommendations.

Mayor Kirk — Mayor Kirk inquired if anyone present wished to speak against the recommendations and no one appeared.

Motion -- — Kirk moved that the City Commission concur with the recommendations of the Planning and Economic Development Commissions.

Comm. Wright — Commissioner Wright thanked the task force members for their efforts in this study.

Mayor Kirk — Discussion was had on the motion and Mayor Kirk stated that it was his intent that the three additional specific recommendations outlined be approved also, and that the specifications would apply to new projects but not to those in process now.

-- carried — Motion carried 5 to 0.

PUBLIC HEARING ON DOWNTOWN BUS LINEUP LOCATIONS — PUBLIC HEARING ON DOWNTOWN BUS LINEUP LOCATIONS, presented.

Redevelopment activities in downtown Wichita have generated interest in possible relocation of the present transit lineup at Broadway and Douglas. Originally ten (10) sites were evaluated based on comparability to the existing lineup at Broadway and Douglas. Site analysis was undertaken with the assumption that little or no capital funds would be available in the near future to implement an off-street facility for the bus lineup.

12. REPORT ON COST-EFFECTIVENESS STUDY OF SEWER PIPE MATERIALS.

In December 1981, due to differences of opinion concerning the relative merits of various storm sewer pipe materials, the City Commission directed the Metropolitan Area Planning Commission (MAPC) to proceed with a study of different storm sewer pipe materials. A task force comprised of the following persons was then appointed by the Chairman of the Planning Commission:

1) George Wilton (Chairman)
2) Chris Breitenstein, Drainage Engineer, City of Wichita
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5) M.S. Mitchell, Private Consultant
6) Bill Otten, Chief Water Engineer, City of Wichita
7) I.L. Penner, Private Consultant
8) Don Schneider, Sanitary Sewer Engineer, City of Wichita
9) Mike Thompson, Poe and Associates, P.A.

Seven open meetings were held with public notice provided. At those meetings different material suppliers were given the opportunity to express their views and make information available to the task force.

The task force report, unanimously approved by both the MAPC and Economic Development Commission, contains the following recommendations:

--A recommendation for hydraulic "N" valves which more correctly reflect flow conditions in the field.

--A recommendation that the minimum allowable thickness of corrugated steel pipe be established at 0.109 inches or 12 gauge in order to increase its predicted service life.

--A recommendation that smooth bituminous coatings and pavings in corrugated steel pipe no longer be permitted because of insufficient durability.

--A recommendation that the City of Wichita's installation specifications for storm and sanitary sewer be rewitten in order to be more clear and less open-ended.

--A recommendation that storm sewer pipe materials currently not being used by the City be specified for test installations.

During the Planning Commission and Economic Development Commission discussions, three additional specific recommendations were approved:

1) That the City Commission direct administrative staff to proceed immediately with implementation of the report recommendations.

2) That, after a period of six months, the task force be reconvened to review the progress made toward implementation of the recommendations.

3) That a professional consultant be hired to rewrite the City's installation specifications, including a separation of the requirements for rigid and flexible pipes.

Letters from manufacturers of corrugated steel pipe who object to the conclusions and recommendations of the report have been provided.

It is recommended that the Commission concur with the recommendations of the Planning and Economic Development Commissions to include the three specific recommendations outlined above.

Representatives of the MAPC and Economic Development Commission and administrative staff will be available to make the presentation and respond to questions.

ACTION: Concur with the recommendations of the Planning and Economic Development Commissions.

October 4, 1982

The Board of City Commissioners (through E. H. Denton, City Manager)

Robert A. Lakin, Director of Planning

DR 82-23 - Presentation of Cost-Effectiveness Study of Sewer Pipe Materials

In December of last year, the Board of City Commissioners directed the Metropolitan Area Planning Commission to proceed with a study of different storm sewer pipe materials. On December 10, 1981, James Gardner, II, then Chairman of the Planning Commission, appointed a Task Force to identify the issues surrounding the use of alternate materials. The Task Force consisted of the following persons:

1. George Wilton - Chairman
2. Chris Breitenstein - Drainage Engineer, City of Wichita
3. Charles Freund - Professional Engineering Consultants, P.A.
4. Max Hubbell - Campbell and Castle, Engineers, P.A.
5. M. S. Mitchell - Private Consultant
6. Bill Otten - Chief Water Engineer, City of Wichita
7. I. A. Penner - Private Consultant
8. Don Schneider - Sanitary Sewer Engineer, City of Wichita
9. Mike Thompson - Poe and Associates, P.A.

The Task Force was organized into sub-committees to study four major subject areas. These subject areas were as follows:

- Hydraulic equivalence
- Service life
- Installation specifications
- Maintenance

Seven open meetings, for which public notice was given, were held. It was at those meetings that the different material suppliers were provided the opportunity to express their views and make information available to the Task Force.

Attached is the report of the Task Force. The major outcomes discussed in the study include:

- A recommendation for hydraulic "N" valves which more correctly reflect flow conditions in the field;

- A recommendation that the minimum allowable thickness of corrugated steel pipe be established at 0.109 inches or 12 gauge in order to increase its predicted service life;

- A recommendation that smooth bituminous coatings and pavings in corrugated steel pipe no longer be permitted, because of insufficient durability;

- A recommendation that the City of Wichita's installation specifications for storm and sanitary sewer be rewritten in order to be more clear and less open-ended;

- A recommendation that storm sewer pipe materials currently not being used by the City be specified for test installations.

On July 29, 1982, the Task Force voted 7-2 to adopt the report and forward it on to the Metropolitan Area Planning and Economic Development Commissions for review prior to it being placed before the Board of City Commissioners. The Planning Commission reviewed the report on September 9, 1982, and the Economic Development Commission reviewed it two weeks later on September 23, 1982. Both Commissions unanimously approved the report and recommended to the City Commission that the report's recommendations be implemented as rapidly as possible.

During the Planning and Economic Development Commission's review of the report, three specific recommendations were discussed. These recommendations were as follows:

1. That the Board of City Commissioners direct the Director of Engineering to proceed with immediate implementation of the report;

2. That, after a period of six months, the Task Force be reconvened to review the progress made toward implementation of the report;

3. That a professional consultant be hired to rewrite the City's installation specifications, including a separation of the requirements for rigid and flexible pipes.

During the processing of the study through the Planning and Economic Development Commissions, three letters were received from affected corrugated steel pipe manufacturers. Copies of these letters are attached for your reference and information.

Recommendation:

It is recommended that the Board of City Commissioners concur with the recommendations of the Planning and Economic Development Commissions including the three specific recommendations outlined above.

Respectfully submitted,

Robert A. Lakin
Director of Planning
RAL:FLN:bh
cc: Task Force on Storm Sewer Pipe Materials
R. W. Bruggeman, P.E., Director of Engineering
Darwin L. Christensen, P. E., Kaiser Aluminum
Donald E. Doerhoefer, Spiral Engineered Systems
Clinton Dunn, P.E., J and J Metal Products
Merl D. Francis, Big R Manufacturing and Distributing, Inc.
Don Gibbs, Millcon Corporation
Robert L. Meinzer, P.E., ARMCO, Inc.
Tom Nearn, P.E., Kaiser Aluminum
Bob Reinke, ARMCO, Inc.
Mike Rice, J and J Metal Products, Inc.
Thomas E. Selders, Big R Manufacturing and Distributing, Inc.
John Wesselhoff, P.E., National Corrugated Steel Pipe Association
Darrell R, Brewer, Jr., Superintendent of Sewer Maintenance
Don E. Anderson, Director, Department of Housing and Economic Development
James L. Gardner, II, Metropolitan Area Planning Commission
Joel Pollack, Chairman, Economic Development Commission

ALSO SENT TO:

JOHN KLYNKOOP, WATER DEPARTMENT.

ARMCO

ARMCO CONSTRUCTION PRODUCTS DIVISION

September 8, 1982

Mr. Robert A. Lakin
Director of Planning
Metropolitan Area Planning Commission
City Building
Wichita, Kansas

Dear Mr. Lakin,

I would like to take exception to the title of the "Cost-Effectiveness Study on Storm Sewer Pipe Materials". At no time during these meetings, were costs discussed. This whole report is strictly concerned with the hydraulic design and installation of corrugated steel pipe.

Very truly yours,

Robert G. Reinke

Robert G. Reinke
Sales Engineer

ARMCO INC. • CONSTRUCTION PRODUCTS DIVISION • SUITE 10, 900 NORTH TYLER ROAD, WICHITA, KS 67212

J & J DRAINAGE PRODUCTS CO.

P.O. Box 829 Hutchinson, Kansas 67501 Telephone (316) 663-1575

Office and Plant
located at
110 North Pershing

September 20, 1982

METROPOLITAN AREA PLANNING DEPT
City Hall - Tenth Floor
455 North Main Street
Wichita, Kansas 67202

Attention: Mr. Robert Lakin
Director of Planning

Sir;

Thank you for the time and effort you spent in preparing Agendas, Minutes and Reports regarding the Task Force on storm sewer pipe in the City of Wichita.

Unfortunately, we the undersigned take exception to the conclusions and recommendations of the finished document presented to the Metropolitan Area Planning Commission on September 9, 1982. The position of corrugated steel pipe has not been given the considerations implied by testimonies throughout the Task Force meetings.

Since we disagree with the conclusions and recommendations we must withdraw our names from the acknowledgements section of the final document.

Mike Rice
Mike Rice
J & J DRAINAGE PRODUCTS
Box 829
Hutchinson, KS 67501

C. E. DUNN P.E.
C E Dunn
J & J METAL PRODUCTS CO
Box 347
Paola, KS 66071

John Wesselhoff, P.E.
J Wesselhoff
NATIONAL CORRUGATED STEEL PIPE ASSOCN
9340 N Timber Terrace
Peoria, Illinois 61615

RECEIVED
SEP 22 1982
METROPOLITAN PLANNING
ROUTE ☐ _____
☐ _____

Member of Corrugated Steel Pipe Associations

J & J METAL PRODUCTS CO.
PAOLA OFFICE & PLANT P.O. BOX 347 PAOLA, KS 66071
Phone 913 294 2342 · KANSAS CITY 913 384 1967 · HAYS PLANT 913 625 5648

September 21, 1982

Metro Area Planning Dept.
City Hall
10th Floor
455 N. Main
Wichita, KS 67202

RECEIVED
SEP 23 1982
METROPOLITAN PLANNING
ROUTE ☐ _____
☐ _____

Attn: Robert A. Lakin
Director of Planning

Ref : Cost Effectiveness Study
on Storm Sewer Pipe Materials

Dear Sir:

I do not agree with the recommendations proposed on the reference subject by the Task Force Committee. I offer the following for the basis of my rebuttal:

Task Force Recommendation:

I.) Change "N" values to match flow conditions in the field:

A.) Flow conditions change primarily because of problems during installation. Contractors are the best judge of installation problems and their comments were not solicited.

Task Force Recommendation:

II.) Establish 12ga as the minimum thickness for corrugated steel pipe.

A.) This gage was established using an abrasion rate for culverts. This abrasion rate does not apply to storm sewer installations because they are not exposed to the severe environments that exist with culverts. This abrasion rate was arbitrarily chosen by the Task Force; there is no data available to support the use of this rate in the City of Wichita. In fact, a study by the Kansas Dept. of Transportation of nearly 1,000 culverts found that abrasion was not a factor and long service life could be expected for corrugated steel pipe. Consequently, the

minimum gage established by KDOT is 16ga

KDOT also promotes alternates for drainage structures allowing concrete pipe, corrugated steel pipe and reinforced box culverts. Alternates are also promoted for storm sewers using a smooth wall or a corrugated design system. This method allows design engineers flexibility and the contractors have several competitive material options.

Task Force Recommendation:

III.) Installation specification changes:

A.) Any changes in the existing city specifications should be based upon the unbiased opinions of contractors. No contractors were surveyed.

Task Force Recommendation:

IV.) Test installations for pipe materials:

A.) These installations should be made using all types of pipe materials; concrete pipe included. Installation sites should be picked based upon varying soil chemistry as classified by the Soil Conservation Sevice. (It is noteworthy that this government agency was not contacted by the Task Force).

If indeed this study is meant to analyze the impact of street and drainage improvements on the cost of housing; "installed" price comparisons should be made. Otherwise the title "cost effectiveness" should be dropped. I also urge the City Commissioners to allow the City Engineering Department latitude of design so they can implement changes in the "state of the act". In this way, alternates can evolve that will be of benefit to all.

Sincerely,

J & J METAL PRODUCTS COMPANY

Clinton E. Dunn

Clinton E. Dunn, P.E.

CED:mt

October 4, 1982

Task Force on Storm Sewer Pipe Materials

Forrest L. Nagley, Junior Planner

Wichita Board of City Commissioners' Review of Cost-Effectiveness Study on Storm Sewer Pipe Materials - DR 82-23

The Task Force's study on storm sewer pipe materials is scheduled for review by the City Commission on October 12, 1982. This item will be included as part of the Manager's agenda. The meeting will begin at 9:00 a.m., in the City Commission Chambers, first floor, City Hall, 455 N. Main.

A copy of Mr. Lakin's memorandum to the City Commission is attached for your reference and information. Should you have any questions about this matter, please feel free to call me at 316-268-4421.

Forrest L. Nagley
Junior Planner

FLN:bh

cc: R. W. Bruggeman, P.E., Director of Engineering
Darwin L. Christensen, P.E., Kaiser Aluminum
Donald E. Doerhoefer, Spiral Engineered Systems
Clinton Dunn, P.E., J and J Metal Products
Merl D. Francis, Big R Manufacturing and Distributing, Inc.
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Robert L. Meinzer, P.E., ARMCO, Inc.
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Darrell R. Brewer, Jr., Superintendent of Sewer Maintenance
Don E. Anderson, Director, Department of Housing and Economic Development
James L. Gardner, II, Metropolitan Area Planning Commission
Joel Pollack, Chairman, Economic Development Commission
Phil Dietrich, Senior Civil Engineer, Sedgwick County Department of Public Works
Douglas Hahn, Ph.d., Sedgwick County Department of Environmental Resources
Dave Flory, Wichita, Kansas

October 5, 1982

Consulting Engineers

Forrest L. Nagley, Junior Planner

Wichita Board of City Commissioners' review of Cost-Effectiveness Study on Storm Sewer Pipe Materials - DR 82-23

The above-referenced document is scheduled for review by the City Commission on October 12, 1982. This matter will be included as part of the Manager's agenda. The meeting will begin at 9:00 a.m., in the City Commission Chambers, First Floor, City Hall, 455 N. Main.

A copy of Mr. Lakin's memorandum to the City Commission is attached for your reference and information. Should you have any questions about this matter, please call me at 268-4421.

Forrest L. Nagley
Junior Planner

FLN:bh

Attachment

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R. Chandler, P.E., Wilson and Company
C. Goodness, P.E., Reiss and Goodness
Don Moehring, P.E., Moehring and Associates
W. Freund, P. E., Booker and Freund Associates
O. Daniels, P.E., Engineering Test Company
Bob Friesen, P.E., The Law Company
F. Roedell, P.E., B.E. and C. Engineers
D. Winfrey, P.E., Winfrey Engineering Services
Brent Wooten, P.E., Baughman Company, P.A.
William Keltner, P.E., Allied Laboratories

October 6, 1982

Interested Individuals and Organizations

Forrest L. Nagley, Junior Planner

Wichita Board of City Commissioners' Review of Cost-Effectiveness Study on Storm Sewer Pipe Materials - DR 82-23

Over the last ten months you have been receiving the meeting notice and agenda for the meetings of the Task Force on Storm Sewer Pipe Materials. The Task Force completed their study in August of this year and the document will be considered by the Board of City Commissioners on Tuesday, October 12, 1982. The meeting will begin at 9:00 a.m., in the City Commission Chambers, first floor, City Hall, 455 N. Main.

A copy of Mr. Lakin's memorandum to the City Commission is attached for your reference and information. Should you have any questions about this matter, please call me at 268-4421.

Forrest L. Nagley
Junior Planner

FLN:bh

Attachment

cc: Tracy Burton, Wichita, Kansas
Stephen Clark, Clark Realtors
Anita Frey, Frey Realtors
Tom Ritchie, Ritchie Paving
Larry Martin, Mid-Kansas Construction, Inc.
George Tomlin, Major, Inc.
Lowell Richardson, Mid-Kansas Federal Savings and Loan
David Stowe, Director, Operations and Maintenance
Karl Kennedy, Industrial Development
Russell Brenner, Director of Administration
John Dekker, Law Department
William Rustin, County Counselor
Tom Powell, Law Department
Wichita Metropolitan Area Board of Realtors, Inc.
Wichita Area Builders Association
Earl T. Graves, Wheeler, Kelly, Hagney Company, Inc.
Sedgwick County Public Information Office
City of Wichita Public Information Office
Citizens Participation Organization

September 27, 1982

Task Force of Storm Sewer Pipe Materials

Forrest L. Nagley, Junior Planner

Cost-Effectiveness Study on Storm Sewer Pipe Materials

On Thursday, September 23, 1982, the Economic Development Commission considered the above-referenced document. The action of the Commission was to approve the study of the Task Force and forward the study to the Board of City Commissioners with the following three-fold recommendation:

1. That the Board of City Commissioners direct the Director of Engineering to proceed with immediate implementation of the report;

2. That, after a period of six months, the Task Force be reconvened to review the progress made toward implementation of the report;

3. That a professional consultant be hired to rewrite the City's instaliation specifications, including a separation of the requirements for rigid and flexible pipes.

Forrest L. Nagley
Junior Planner

FLN:bh

cc: R. W. Bruggeman, P.E., Director of Engineering
Darwin L. Christensen, P.E., Kaiser Aluminum
Donald E. Doerhoefer, Spiral Engineered Systems
Clinton Dunn, P.E., J and J Metal Products
Merl D. Francis, Big R Manufacturing and Distributing, Inc.
Don Gibbs, Milloon Corporation
Robert L. Meinzer, P.E., ARMCO, Inc.
Tom Nearn, P.E., Kaiser Aluminum
Bob Reinke, ARMCO, Inc.
Mike Rice, J and J Metal Products, Inc.
Thomas E. Selders, Big R Manufacturing and Distributing, Inc.
John Wesselhoff, P.E., National Corrugated Steel Pipe Assoc.
Darrel R. Brewer, Jr., Superintendent of Sewer Maintenance
John D. Wynkoop, Director of Water and Water Pollution Control
Joel M. Pollack, Chairman, Economic Development Commission
James Gardner, II, Metropolitan Area Planning Commission
Phil Dietrich, Senior Civil Engineer, Sedgwick County Department of Public Works
Douglas Hahn, Ph.D., Sedgwick County Department of Environmental Resources

Dave Flory, Wichita, Kansas
Don Anderson, Director, Department of Housing and Economic Development

MINUTES

Economic Development Commission
Meeting

September 23, 1982

Members Present: Joel Pollack; Ernestine Henderson; Linda Ayala; Tracy Burton; Steve Clark; Dr. Othello Curry; Morris Krouse; Larry Payne; Rod Stewart

Members Absent: Anita Frey

Also Present: Don E. Anderson; Frank Smith; Wayne Isaac; Lynda Tousley; Nelson Hall; Marian Grubb

CALL TO ORDER

The meeting was called to order by Joel Pollack, chairperson, at 9:35 a.m.

APPROVAL OF MINUTES

Burton moved to approve the minutes of September 9, 1982 meeting; seconded by Clark; carried unanimously.

COST EFFECTIVENESS STUDY OF SEWER PIPE MATERIALS

Burton requested that Item 6 (Cost Effectiveness Study of Sewer Pipe Materials) be taken up at this time owing to fact that several persons were in attendance for this item. No objection was raised.

The matter of the cost effectiveness study of sewer pipe materials (Item 6) was presented.

Pollack stated that members had received a copy of Bob Lakin's two memorandums along with report prepared by task force. Pollack's comments included, in part:

- study came about in area of new construction projects for storm water sewers and when steel and when concrete pipe would be used; when both would be bid; what tolerances would be bid if bidding both, etc.
- City Engineering felt some advice was needed in this area; and City Commission suggested that study be done and task force set up to study problem and come up with most cost effective way to handle it.
- Jim Gardner, Jr., then chairman of MAPC, was charged with directing task force.
- Planning Commission approved task force report and it was now being presented to EDC with recommendation that it be approved and forwarded to City Commission for implementation.

Payne questioned where cost effectiveness came in. Pollack stated that it concerned length of service life of pipe - whether steel product was comparable to concrete and at what gauge in thickness.

- MOTION to approve report

Burton moved that EDC approve report and forward to City Commission for implementation; seconded by Krouse.

Jim Gardner, Jr., member of Planning Commission, stated that in terms of the motion he felt it would probably be best to have a three-fold motion which would include the following elements:

1. Planning Commission recommended that City Commission recommend the immediate implementation of the report by Engineering.

2. After the recommendation for immediate implementation by Engineering there was a recommendation that the committee be reconvened in six months for a review of what had occurred to that point.

3. There was a recommendation to hire a professional consultant to rewrite the installation specifications separating rigid and flexible pipes.

Gardner stated that the last two elements were comments in report but felt they would carry more weight if they were formal elements of recommendation to City Commission.

- MOTION amended

Burton moved that his motion be modified to include the above three recommendations; seconded by Krouse.

Amendment and motion as amended carried unanimously.

1983-88 CIP

The matter of 1983-88 Capital Improvement Program (Item 3) was presented. Pollack asked members if they had any items to be suggested for inclusion in CIP.

Burton asked what time frame was for items to be submitted. Anderson replied that deadline was tomorrow but that it was an ongoing process; that items probably could be submitted over the next couple of months but that initially Budget Office would like to have them in by end of month.

Anderson stated that his department would be submitting some requests - principally those submitted in past and included in present CIP which would be modified somewhat such as downtown parking garages; a new project covering parking garage to serve Century II and new convention center; and removal of Royale project which was no longer viable.

Burton requested that this item be brought back after other items had been discussed, such as convention center site acquisition, so that discussion on the parking garages, etc., might be more meaningful. It was generally agreed.

Anderson stated that staff had also included in CIP $100,000 which was available for economic and industrial development - for opportunity investments which would allow City to participate with new business or expansion of one and to provide some incentives. He further stated that this had been in CIP budget for couple of years and that $100,000 probably wasn't enough if City were to get involved in a major project.

Notes from E.D.C. mtg.

Pollack – introduces item

held over project from Bd of Land Use Economics

outlines matter.

mentions membership of Task Force.

# of meetings (open meetings)

Howard Payne + questions title – "cost effectiveness"?

Pollack explains +

Gardner – 3 fold motion.

1. P.C. recom. to B.C.C. – recommend immediate imple. by City Engineering.

recruiting in 6 months.

hire profess. consultant to rewrite ~~specifications~~.

FROM _____ DATE _____

ADMINISTRATION	ADVANCE PLANS	CURRENT PLANS	GRAPHICS
☐ Lakin	☐ Stockwell	☒ ~~Galbraith~~	☐ Pierce
☐ Walter	☐ Schwartz	☐ Lytle	☐ Commer
☐ Doramus	☐ Leivo	☐ Young	☐ Crook
☐ Eubanks	☐ Bechtel	☐ Chambers	☐ Garland
☐ Hanson	☐ Curfman	☐ Fleck	☐ Singhal
☐ Henderson	☐ Dudark	☑ Nagley	☐ Whitney
☐ Lakin, E.	☐ Flynn	☐ Olivarez	☐ —
☐ Nelson	☐ Hart	☐ Shirkey	
☐ Scott	☐ Losew	☐ McDonald	
☐ —	☐ Shen		
	☐ Spain		
	☐ Vinson		
	☐ —		

○ Note & Return	○ Signature
○ Handle	○ Library
○ All Staff	○ Information
○ Comment	○ Files

REMARKS Prep for BCC. Check w/ Garland w/ Dan for appropriate Dayer + content & transmittal mailed

T9-105

THE CITY OF WICHITA

OFFICE OF Housing and Economic Development **DATE** September 27, 1982

TO Robert A. Lakin, Director of Planning

FROM Don E. Anderson, Director of Housing and Economic Development

SUBJECT Cost Effectiveness Study of Sewer Pipe Materials

The Economic Development Commission at its regular meeting of September 23 approved subject study prepared by Task Force and the following elements for recommendation to the City Commission.

1. That City Commission recommend the immediate implementation of the report by Engineering.

2. That after the recommendation for immediate implementation by Engineering the task force be reconvened in six months for a review of what had occurred to that point.

3. That a professional consultant be hired to rewrite the installation specifications separating rigid and flexible pipes.

Don E. Anderson, Director
Housing and Economic Development

DEA:mw

cc: Forrest Nagley

September 24, 1982

Task Force on Storm Sewer Pipe Materials

Forrest L. Nagley, Junior Planner

Forwarding of letters from steel pipe manufacturers

Attached please find the following letters received by Mr. Lakin regarding the report prepared by the Task Force:

1. September 8, 1982 - Robert G. Reinke, ARMCO;
2. September 20, 1982 - J and J Drainage Products Company;
3. September 21, 1982 - J and J Metal Products Company.

Copies of these letters are provided for your information. They will be included as part of the material to be provided to the Board of City Commissioners when they review the report.

Forrest L. Nagley
Junior Planner

FLN:bh

Attachments (3)

cc: Robert G. Reinke, Sales Engineer, ARMCO, Inc., Suite 10, 900 N. Tyler Rd., Wichita, Kansas 67212
Mike Rice, J and J Drainage Products, Box 829, Hutchinson, Kansas 67501
C. E. Dunn, P. E., J and J Metal Products Company, Box 347, Paola, Kansas 66071
John Wesselhoff, P.E., National Corrugated Steel Pipe Association, 9340 N. Timber Terrace, Peoria, Illinois, 61616

bcc: Joel Pollack, Jim Smith Realty, Inc., 337 N. Waco, 67202
James Gardner, 601 N. Broadway, 67214

Forest Nagle
Planning

AGENDA

Economic Development Commission

September 23, 1982

Board Room, First Floor, Wichita City Hall
9:30 a.m.

1. Call to order.

2. Approval of minutes of September 9, 1982 meeting.

3. 1983-88 Capital Improvement Program

   Consideration of possible projects to be included in 1983-88 CIP.

4. Convention Center - Site Acquisition

   Don Anderson will report on the recommendation made by the Convention Center Advisory Team and City Committee at their joint meeting held on Monday, September 20.

5. Status report on contracts on GSA Site

   Don Anderson will make report at meeting.

6. Cost Effectiveness Study of Sewer Pipe Materials.

   Review the study, prepared by Task Force on Storm Sewer Pipe Materials, and receive and file.

7. Lease Agreement with Century "21" Wichita Brokers Council for rental of Grand Hotel building for a Halloween haunted house to benefit Easter Seals.

   Lease provides for a rental payment of $100 and a security deposit of $500 with term of lease to run from September 15, 1982 through November 5, 1982.

   Staff recommends that EDC approve lease.

8. Redevelopment of Surplus Land Parcel S-1 Commonly Referred to as the FHA Tract.

   Following a complete staff report on this item the EDC will be asked to assist in the development of final procedural plans in the redevelopment of this parcel.

9. Other business

10. Adjournment

J & J METAL PRODUCTS CO.
PAOLA OFFICE & PLANT P.O. BOX 347 PAOLA, KS 66071
Phone 913 294 2342 · KANSAS CITY 913 384 1967 · HAYS PLANT 913 625 5648

September 21, 1982

Metro Area Planning Dept.
City Hall
10th Floor
455 N. Main
Wichita, KS 67202

Attn: Robert A. Lakin
Director of Planning

Ref : Cost Effectiveness Study
on Storm Sewer Pipe Materials

Dear Sir:

I do not agree with the recommendations proposed on the reference subject by the Task Force Committee. I offer the following for the basis of my rebuttal:

Task Force Recommendation:

I.) Change "N" values to match flow conditions in the field:

A.) Flow conditions change primarily because of problems during installation. Contractors are the best judge of installation problems and their comments were not solicited.

Task Force Recommendation:

II.) Establish 12ga as the minimum thickness for corrugated steel pipe.

A.) This gage was established using an abrasion rate for culverts. This abrasion rate does not apply to storm sewer installations because they are not exposed to the severe environments that exist with culverts. This abrasion rate was arbitrarily chosen by the Task Force; there is no data available to support the use of this rate in the City of Wichita. In fact, a study by the Kansas Dept. of Transportation of nearly 1,000 culverts found that abrasion was not a factor and long service life could be expected for corrugated steel pipe. Consequently, the

minimum gage established by KDOT is 16ga

KDOT also promotes alternates for drainage structures allowing concrete pipe, corrugated steel pipe and reinforced box culverts. Alternates are also promoted for storm sewers using a smooth wall or a corrugated design system. This method allows design engineers flexibility and the contractors have several competitive material options.

Task Force Recommendation:

III.) Installation specification changes:

A.) Any changes in the existing city specifications should be based upon the unbiased opinions of contractors. No contractors were surveyed.

Task Force Recommendation:

IV.) Test installations for pipe materials:

A.) These installations should be made using all types of pipe materials; concrete pipe included. Installation sites should be picked based upon varying soil chemistry as classified by the Soil Conservation Sevice. (It is noteworthy that this government agency was not contacted by the Task Force).

If indeed this study is meant to analyze the impact of street and drainage improvements on the cost of housing; "installed" price comparisons should be made. Otherwise the title "cost effectiveness" should be dropped. I also urge the City Commissioners to allow the City Engineering Department latitude of design so they can implement changes in the "state of the act". In this way, alternates can evolve that will be of benefit to all.

Sincerely,

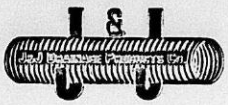
J & J METAL PRODUCTS COMPANY

Clinton E. Dunn

Clinton E. Dunn, P.E.

CED:mt

J & J DRAINAGE PRODUCTS CO.



P.O. Box 829 Hutchinson, Kansas 67501 Telephone (316) 663-1575

Officeland Plant
located at
110 North Pershing

September 20, 1982

METROPOLITAN AREA PLANNING DEPT
City Hall - Tenth Floor
455 North Main Street
Wichita, Kansas 67202

Attention: Mr. Robert Lakin
Director of Planning

Sir;

Thank you for the time and effort you spent in preparing Agendas, Minutes and Reports regarding the Task Force on storm sewer pipe in the City of Wichita.

Unfortunately, we the undersigned take exception to the conclusions and recommendations of the finished document presented to the Metropolitan Area Planning Commission on September 9, 1982. The position of corrugated steel pipe has not been given the considerations implied by testimonies throughout the Task Force meetings.

Since we disagree with the conclusions and recommendations we must withdraw our names from the acknowledgements section of the final document.

Mike Rice
Mike Rice
J & J DRAINAGE PRODUCTS
Box 829
Hutchinson, KS 67501

C. E. DUNN, P.E.
C E Dunn
J & J METAL PRODUCTS CO
Box 347
Paola, KS 66071

John Wesselhoff, P.E.
J Wesselhoff
NATIONAL CORRUGATED STEEL PIPE ASSOCN
9340 N Timber Terrace
Peoria, Illinois 61615

RECEIVED
SEP 22 1982
METROPOLITAN PLANNING
ROUTE ☐ _____
☐ _____

Member of Corrugated Steel Pipe Associations

WICHITA-SEDGWICK COUNTY

METROPOLITAN AREA PLANNING DEPARTMENT

DATE September 15, 1982

TO Task Force on Storm Sewer Pipe Materials

FROM Forrest L. Nagley, Junior Planner, Current Plans Division

SUBJECT Cost-Effectiveness Study on Storm Sewer Pipe Materials

On Thursday, September 9, 1982, the Metropolitan Area Planning Commission considered the above-referenced document. The action of the Commission was to "accept the report and forward it to the Board of City Commissioners with the recommendation that it be implemented as rapidly as possible."

The report will next be reviewed by the Economic Development Commission on Thursday, September 23, 1982. This meeting will begin at 9:30 a.m. in the Board Room, First Floor, City Hall, 455 North Main. Attached is a copy of Mr. Lakin's memorandum to Mr. Anderson regarding this matter.

Forrest L. Nagley

Forrest L. Nagley, Junior Planner

FLN:vn
Attachment
cc: R. W. Bruggeman, P.E., Director of Engineering
Darwin L. Christensen, P.E. Kaiser Aluminum
Donald E. Doerhoefer, Spiral Engineered Systems
Clinton Dunn, P.E., J.& J. Metal Products
Merl D. Francis, Big R Manufacturing and Distributing, Inc.
Robert L. Meinzer, P.E., ARMCO, Inc.
Tom Nearn, P.E., Kaiser Aluminum
Bob Reinke, ARMCO, Inc.
Mike Rice, J & J Metal Products, Inc.
Thomas E. Selders, Big R Manufacturing and Distributing, Inc.
John Wesselhoff, P.E., National Corrugated Steel Pipe Assoc.
Darrel R. Brewer, Jr., Superintendent of Sewer Maintenance
John D. Wynkoop, Director of Water and Water Pollution Control
Joel M. Pollack, Chairman, Economic Development Commission
James Gardner, II, Metropolitan Area Planning Commission
Phil Dietrich, Senior Civil Engineer, Sedgwick County Department of Public Works
Douglas Hahn, Ph.D., Sedgwick County Department of Environmental Resources
Dave Flory, Wichita, Kansas

Add Don Gibbs, Millcon Corp.

Also sent memo & attachment to Don Gibbs at Millcon. His name was inadvertently left off of the cc list for this memo.

FLN
9/16/82

WICHITA-SEDGWICK COUNTY

METROPOLITAN AREA PLANNING DEPARTMENT

DATE September 15, 1982

TO Consulting Engineers

FROM Forrest L. Nagley, Junior Planner, Current Plans Division

SUBJECT Cost-Effectiveness Study on Storm Sewer Pipe Materials

On Thursday, September 9, 1982, the Metropolitan Area Planning Commission considered the above-referenced document. The action of the Commission was to "accept the report and forward it to the Board of City Commissioners with the recommendation that it be implemented as rapidly as possible."

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Forrest L. Nagley

Forrest L. Nagley, Junior Planner

FLN:vn

cc: Ken Bengston, P.E., Van Doren-Hazard-Stallings
R. Chandler, P.E., Wilson and Company
C. Goodness, P.E., Reiss and Goodness
Don Moehring, P.E., Moehring and Associates
W. Freund, P.E., Booker and Freund Associates
O. Daniels, P.E., Engineering Testing Company
Bob Friesen, P.E., The Law Company
F. Roedell, P.E., B.E. and C. Engineers
D. Winfrey, P.E., Winfrey Engineering Services
Brent Wooten, P.E., Baughman Company
William Keltner, P.E., Allied Laboratories

WICHITA-SEDGWICK COUNTY

METROPOLITAN AREA PLANNING DEPARTMENT

DATE September 15, 1982

TO Interested Individuals and Organizations

FROM Forrest L. Nagley, Junior Planner, Current Plans Division

SUBJECT Cost-Effectiveness Study on Storm Sewer Pipe Materials

On Thursday, September 9, 1982, the Metropolitan Area Planning Commission considered the above-referenced document. The action of the Commission was to "accept the report and forward it to the Board of City Commissioners with the recommendation that it be implemented as rapidly as possible."

The report will next be reviewed by the Economic Development Commission on Thursday, September 23, 1982. This meeting will begin at 9:30 a.m. in the Board Room, First Floor, City Hall, 455 North Main.

Forrest L. Nagley

Forrest L. Nagley, Junior Planner

FLN:vn

cc: Tracy Burton, Wichita, Kansas
Stephen Clark, Clark Realtors
Anita Frey, Frey Realtors
Tom Ritchie, Ritchie Paving
Larry Martin, Mid-Kansas Construction Co., Inc.
George Tomlin, Major, Inc.
Lowell Richardson, Mid-Kansas Federal Savings and Loan
David Stowe, Director, Operations and Maintenance
Karl Kennedy, Industrial Development
Russell Brenner, Director of Administration
John Dekker, Law Department
William Rustin, County Counselor
Tom Powell, Law Department
Wichita Metropolitan Area Board of Realtors, Inc.
Wichita Area Builders Association
Earl T. Graves, Wheeler, Kelly and Hagney Inc. Co.
Citizens Participation Organization
Sedgwick County Public Information Office
City of Wichita Public Information Office

September 14, 1982

Donald E. Anderson, Director of Housing and Economic Development

Robert A. Lakin, Director of Planning

AGENDA ITEM FOR SEPTEMBER 23, 1982, MEETING OF THE ECONOMIC DEVELOPMENT COMMISSION

In December of last year, the Board of City Commissioners directed the Metropolitan Area Planning Commission to proceed with a study of different storm sewer pipe materials. On December 10, 1981, Chairman Gardner appointed a Task Force to identify the issues surrounding the cost-effectiveness of alternate materials. The Task Force consisted of the following persons:

1. George Wilton - Chairman
2. Chris Breitenstein - Drainage Engineer, City of Wichita
3. Charles Freund - Professional Engineering Consultants, P.A.
4. Max Hubbell - Campbell and Castle Engineers, P.A.
5. M. S. Mitchell - Private Consultant
6. Bill Otten - Chief Water Engineer, City of Wichita
7. I. L. Penner - Private Consultant
8. Don Schneider - Sanitary Sewer Engineer, City of Wichita
9. Mike Thompson - Poe and Associates, P.A.

The Task Force was organized into sub-committees to study four major subject areas. These subject areas were as follows:

- Hydraulic equivalence
- Service life
- Installation specifications
- Maintenance

Seven open meetings, for which public notice was given, were held. It was at those meetings that the different material suppliers were provided the opportunity to express their views and make information available to the Task Force.

Attached is the report of the Task Force. The major outcomes discussed in the study include:

- A recommendation for hydraulic "N" valves which more correctly reflect flow conditions in the field.

- A recommendation that the minimum allowable thickness of corrugated steel pipe be established at 0.109 inches or 12 gauge in order to increase its predicted service life.

- A recommendation that smooth flow bituminous coatings and pavings in corrugated steel pipe no longer be permitted, because of insufficient durability.

- A recommendation that the City of Wichita's installation specifications for storm and sanitary sewer be rewritten in order to be more clear and less open-ended.

- A recommendation that storm sewer pipe materials currently not being used by the City be specified for test installation.

As this study represents an off-shoot of the work begun by the disbanded Board of Land Use Economics, relative to the impact that street and drainage improvements have on the cost of housing, it is felt that the Economic Development Commission should review the report prior to it being forwarded to the Board of City Commissioners. The report was reviewed by the Metropolitan Area Planning Commission on September 9, 1982. The action taken by that commission was to accept the report and forward it to the Board of City Commissioners with the recommendation that it be implemented as rapidly as possible.

Should you have any questions about this matter, or if the report cannot be placed on the September 23, 1982 agenda of the Economic Development Commission, please call me.

Robert A. Lakin, Director of Planning

RAL:FLN:rh
Attachment

BILL KORBER, surveyor, was present to represent the applicant.

There was no one present in opposition to the application.

MOTION: Having considered the factors as contained in Policy Statement No. 10; taking into consideration the mixed residential and commercial character of the general area; the "R-6" zoning to the west; the light commercial zoning to the east; the Turnpike to the south; the fire station and light commercial uses to the east; the lack of opposition from area residents and the recommendation of approval by staff; I move that we recomnend to the governing body that this application be approved subject to recording of the associated plat "Steve Clark 2nd Addition" within one year from the date of approval by the City Commission or the case be considered denied and closed. Chisholm moved, Goebel seconded and it carried unanimously. Jones, Lofton and Parson were absent.

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10. DR 82-23 - Presentation of Cost Effectiveness Study of Storm Sewer Pipe Materials.

LAKIN stated that George Wilton would make the presentation on this item. He said that the Planning Commission had been furnished a cover memorandum on it to give some background because it had been sometime since this was before the Commission.

GEORGE WILTON, Chairman of the Task Force on Storm Sewer Pipe Materials, stated that it had been the practice in the past to design a storm sewer on the basis of concrete pipe, and then to permit alternate bids on paved or coated corrugated steel pipe of the same diameter or plain corrugated steel pipe six inches larger in diameter than the concrete pipe. He said that the Task Force attempted to follow this concept for ease of design and plan preparation. This concept avoided the drawing of separate designs for concrete and corrugated steel pipe. They soon found that this was not going to be possible. He said that it soon became evident that the bituminous paving used on corrugated steel pipe, to give it the smooth service and therefore the same "N" value or roughness coefficient as concrete pipe, did not adhere for the life of the pipe. The Task Force therefore recommended paving or lining not be

permitted. WILTON explained that the practice of permitting an alternate bid to concrete pipe to be a plain corrugated steel pipe six inches larger in diameter was good only for 18-inch and smaller diameter pipes. WILTON, showing a graph, pointed out that the equivalent corrugated metal pipe to an 18-inch concrete pipe is 24 inches. But if the 54-inch concrete pipe is taken, it requires a 71-inch corrugated steel pipe. If a 6-inch larger corrugated pipe is substituted for a 54-inch concrete pipe, it would only provide 60 percent of the design capacity. The difference is more pronounced when larger size pipes are compared and especially so with pipe having 3" x 1" annular corrugations. He said that it was the belief of the Task Force, and particularly those on the Task Force with a maintenance background, that a corrugated steel pipe, with the same slope as a concrete pipe, would introduce a debri deposition problem due to the lower velocity in the corrugated steel pipe. He said that in view of this, the Task Force was recommending that a minimum velocity be approved of two feet per second at a flow depth of 20 percent of the diameter of the pipe.

WILTON continued that a 36-inch concrete pipe at a slope of a little more 1/10th percent would give two feet per second velocity. The two feet per second velocity for the corrugated metal pipe takes a little more than 4/10ths percent slope in order to maintain the same velocity. He said that this does introduce problems regarding depth, and pumping stations are sometimes required. When lines are installed on flat grades they will be extremely expensive to maintain at design capacity.

WILTON said that the service life to be expected from various materials receive considerable attention. The Task Force believes that it took a conservative position when they recommended a minimum wall thickness of 12 gauge be specified for corrugated steel pipe. He said that a representative cross-section of resistivity values throughout the city had been complied by the Engineering Department from information furnished by the ARMCO Company and the Gas Service Company. From charts published by the American Iron and Steel Institute, and from the resistivity values it was determined that an average service life of 77 years could be expected for 12 gauge pipe.

WILTON said that probably the most discussed part of the study had to do with installation specifications. He said that most of the Task Force members felt that a major rewriting of the City specifications for storm sewers should be undertaken by a consultant familiar with pipe laying in Wichita. He said that they were fortunate to have maintenance people on the Task Force and access to the City's television equipment and records. In viewing various lines with the aid

of television, and by actually walking through the larger lines, a number of defects were noted which should have been corrected at contractor expense. These defects were not corrected however, because the lines had not received an examination prior to closing out the project. He said that the Task Force believes that the final examination, whether by TV or walk through, should be made by the people who are going to be responsible for operation and maintenance of the system. He added that this has been done in the case of sanitary sewers for sometime. He said this practice should be expanded to include storm sewers.

WILTON said that the Task Force, in its report, has made a number of recommendations which they would like to see adopted. They believe that after a reasonable length of time they should reconvene to determine if the adopted recommendations have been implemented and if they are working as anticipated.

WILTON stated that he has a letter from ARMCO objecting to the title of the report.

GARDNER asked what was the attendance at the Task Force meetings. He said that it was his impression that they had been attended by a cross-section of manufacturers and contractors, as well as City Engineering staff and other people from the private sector.

WILTON said that he was pleased with the attendance. Most of them were very faithful. They showed up every month.

WILSON asked if everyone concurred in the report.

WILTON said that he did not think that all of the suppliers concurred. The Task Force had voted 7-2 to approve the report.

In this regard, WILTON stated further that the Task Force had heard from the manufacturers of aluminum pipe and plastic pipe. The Task Force feels that the City should work with these materials. He stated that the report suggests getting some in the ground before they are included in the specification as an alternate. He said that there exists some rather good claims on aluminum pipe and plastic pipe, but the Task Force did not feel that they could just blindly accept those claims. They wanted some experience with it first.

WILSON asked if plastic pipe was now a viable alternate for pipe installations of less than 18 inches. He asked what was the life expectancy of concrete.

WILTON said that they considered the life expectancy of concrete pipe to be from 75 to 100 years.

WILSON stated that in the sizing of the steel pipe they refer only to the gauge of the steel, not the coating of the steel. He asked if the coating could be anything.

WILTON said no, the plain corrugated steel that they referred to was galvanized. He said that he tried to make clear that corrugated steel was originally completely paved which made a smooth interior. They found by examining several lines that they were losing this coating so that it really was not right to design it as smooth and end up in 15 to 20 years with a rough pipe. They also found that even where the pipe was just coated with bituminous material that they were losing that coating. They felt the only sure way to get the life of the steel pipe comparable with concrete pipe was to up the thickness, and this thickness was arrived at by using the recommendations from the Iron and Steel Institute on the rate of corrison and abrasion for a steel pipe. He stated that resistivity and PH factor in the soil were also considered.

WILSON asked if the steel pipe industry normally makes a 12 gauge pipe. WILTON said yes.

GARDNER stated that Wilton has been most modest in covering his background with the City previously and his credentials. He asked if Wilton would mind describing the previous 20 years activity that he had.

WILTON said that he had been with the City for 30 years. He retired in 1979. He said that he had been Director of the Flood Control project for 10 years, and for 20 years he had been Superintendent of Maintenance.

GARDNER thanked Wilton for the amount of time that he had put into the study and supervising the Task Force.

DONALD GIBBS, 1575 Timothy, representing Milcon Corporation and their concrete pipe products. He said that the Task Force was made up of nine individuals who were engineers or other technically qualified people. Those were the people who voted on the acceptance of this report. He said that he is a material supplier and none of the material suppliers had a vote on the report. However, during the course of almost the last year there were seven meetings held at which each supplier had an opportunity to provide input and distribute technical literature to the members of the Task Force. GIBBS said that he viewed the report as a very good reasonable compromise of the issues that had been studied for the

last 10 or 12 months. The concrete pipe people did not win every point that they presented. The corrugated steel pipe people did not win every point that they presented, but what they have as a final product, in his judgment and estimation, was a good workable report on which a good deal of time and effort was spent by the nine members of the Task Force. GIBBS said that these were nine individuals that volunteered their time and effort for this project, and he felt that if the City had employed an outside consultant, this report would have cost in the tens of thousands dollars. He said that he expressed appreciation on behalf of himself and his company for the opportunity to be heard by these people.

MIKE RICE, representing J & J Drainage Products of Hutchinson, Kansas. He said that he is a corrugated steel pipe supplier. RICE said that in his company's opinion, most of the data and literature that they had given the Task Force had fallen on deaf ears. Most of the storm sewers in the City of Wichita presently are designed for reinforced concrete pipe either by choice or by design. Corrugated steel pipe has been used and still presently being used all across the State of Kansas and around the world as a viable storm sewer pipe. He said that staying with the straight galvanizing as a coating is fine, but there are other coatings for a culvert pipe, such as polyomiers. These do not lose their adhesiveness. In Wichita they do not have strong velocities to worry about. They are worried about getting the trash out of the pipes, so there are a lot of alternatives to be looked at. RICE said that after attending the meetings he felt that overall there is a place for corrugated steel pipes which does not fit in the final draft and recommendations of the gauges starting with a 12 gauge on a 15 inch pipe. He said that it was very difficult to manufacture pipe in that size with such a heavy gauge. He said that they noticed that the trade-off on the chart gets up to around 54 inch pipe. There is a dramatic difference on the "N" factor between the reinforced concrete pipe and the corrugated steel pipe. He said that most of the storm sewer pipes that he had been concerned with range from 36 inches and smaller. He said that they were being unjustly handicapped. RICE said that some of the consulting engineers that work for the City have computers that could make runs automatically. They simply plug in the numbers and run it through for corrugated steel pipe or for reinforced concrete pipe. He said that it was not uncommon for that to happen. He said that when they get down to the bottom dollar of what the contract is worth, corrugated steel pipe is usually less expensive than reinforced concrete pipe because of the weight and how easily it goes into the ground. He stated that he felt the study had not touched on this.

GARDNER asked Rice if he understood him to say that his firm would be interested in making a nominal size pipe to a specific dimension as opposed to the standard dimensions.

RICE said yes, his firm had no problems with special orders. He said that it had been pointed out although that there may be problems matching pipes on extensions. He said that their corrugated steel pipes are still fabricated by hand and could be made to any dimension.

GARDNER asked if a special order of that nature takes a longer time to produce or to make available for installation.

RICE said no, every pipe is made to order.

GARDNER asked if Rice's firm was somewhat unique in that they have the ability to provide specific sizing which is not necessarily a common feature found in metal pipe industry.

RICE said yes, and that in the State of Kansas, they have three plants. Their competitor has only one.

GARDNER said his point was that at the various meetings comments were made that Rice was in the unique position of having the ability to manufacture pipe to specific dimension, whereas the other firm doesn't necessarily engage in that sort of practice. GARDNER felt that Rice's points were well taken and they were points made at the Task Force meetings.

M. S. MITCHELL, 1215 Forrest, stated that he was a member of the Task Force and a member of the draft committee which helped put the report together. He said that, as a part of putting the report together, he took the time to take every piece of literature furnished by suppliers, and other persons interested in giving information to the Task Force, and break out the specific recommendations contained in the literature that was furnished. He said that he found in his research that there were 163 specific recommendations made by the two suppliers whose products were considered in the final report. MITCHELL said that he broke down these 163 recommendations according to: Accepted, not accepted or not addressed. Of the 27 recommendations for hydraulic equivalency suggested by the reinforced concrete pipe people, 19 percent were accepted, 74 percent were not accepted, and 7 percent were not addressed. For corrugated steel pipe, 20 recommendations made, 15 percent accepted, 65 percent not accepted, 20 percent not addressed. For service life, reinforced concrete pipe made 4 recommendations, 25 percent accepted, 75 percent not accepted, none not addressed.

For corrugated steel pipe, 12 recommendations, 25 percent accepted, 75 percent not accepted, none not addressed. For installation specification, reinforced concrete pipe made 88 recommendations, of which 18 percent were accepted, 10 percent were not accepted, 72 percent were not addressed. Corrugated steel pipe made 10 recommendations, 10 percent were accepted, 40 percent were not accepted, 50 percent were not addressed. For maintenance, reinforced concrete pipe made no recommendations. Corrugated steel pipe made 2 recommendations, neither of which were accepted. The total percentage works out for reinforced concrete pipe, 119 recommendations, of which 18 percent were accepted. Corrugated steel pipe made 44 recommendations, of which 16 percent were accepted.

GARDNER asked if, in the early stages of the group's consideration, there was a feeling that there was a real need to get things to a level of relative equivalency in terms of the manner in which the materials were being used by the City of Wichita.

MITCHELL said that he did not think the Task force or any of the members of the Task Force could give the Commission a definite recommendation on which product would be cheapest as far as the initial bid, the long term service life and future maintenance costs because they have very little control over the activities of a contractor and his abilities and initiative in placing materials in the ground and the manufacturer's ability to get the materials on the site to the contractor. Therefore, for the Task Force to try to put a dollar value on a product that has so many varibles would probably wind up causing more objections than exist over the approach the Task Force did take. He said that in trying to make the products equal they let the free enterprise system of the manufacturer and the installation contractor decide which is the best product for the City. What the Task Force tried to do was to give the Commission recommendations which would make those bids truly equal alternates.

GARDNER asked if these elements of the recommendations were currently found in the City's storm and sanitary sewer installation manual.

MITCHELL said that one of them was.

GARDNER asked if perhaps the bulk of them were not addressed in the installation manual. He asked if there was a feeling that this study in large part attempted to address those areas and if Mitchell thought it would be appropriate if implementation of the report could largely be accomplished by rewriting the sewer specifications.

MITCHELL answered yes.

BAYOUTH commented that if it took a larger pipe of corrugated steel to do the job of a smaller concrete pipe, it would seem to him that installation would be higher. He said he could not see where there would be an equivalence there.

MICTHELL responded that one of the attributes of metal pipe is that it comes in longer joints and sections, and therefore there are fewer number of pieces to put in the ground.

BAYOUTH stated that he felt that once concrete pipe is installed it stays in place. He asked if this was true for corrugated steel.

MITCHELL stated that if the bedding and backfill were properly done, neither material should move, and this was one of the things discussed by the Task Force. He stated that the specifications, in their opinion, do not currently address the different operations necessary to install the two different kinds of pipe. He suggested separate specifications for rigid drainage systems and flexible systems.

WILSON mentioned the letter from ARMCO questioning the title of the study. He stated that he felt it was the wording they were concerned about. He added that this report appeared to him to be a comparison to two products and that the cost would come out in the bidding. MITCHELL stated that was correct. WILSON asked who picked the wording for the title. He said that if this was objectionable to the steel pipe manufacturers, maybe the concrete manufacturers think the same thing.

GARDNER said that he would have to assume responsibility for the wording of the report's title.

WILSON stated that he felt that the Task Force did an excellent job.

MERLE FRANCIS, Phillipsburg, Kansas, stated that he represented a manufacturing company called "Big R", of Greeley, Colorado. He said that they happen to be manufacturers of both steel and aluminum drainage pipe. They are a distributor for Kaiser products. He pointed out that aluminum was somewhat of a stranger in this city, and he thought personally it would be a good time to introduce aluminum. He said that he requested from the Task Force that his company and also Kaiser Aluminum be given a chance to present information about their products. He said that what he really wanted

to say was he appreciated the courtesy and consideration given him.

GARDNER said that Mr. Francis was faithful in attending the sessions, and he appreciated his input.

WILSON asked if this report was going to the City Commission.

GARDNER answered yes, and stated that it would be appropriate for this Commission to recommend to the City Commission that the findings of the Task Force be implemented on a fairly immediate basis by the Department of Engineering. He said that it would affect several areas including design and a number of things. He said that they should recommend that the City Commission consider addressing the need to rewrite the storm sewer installation specifications. He said any rewrite should specifically address both flexible and rigid pipe materials. He stated that he felt rewriting the specifications should be the responsibility of a hired private consultant. He said that there was a need to probably review at some point in the future, maybe six months or so, what progress has been made toward the implementation of the report and towards the drafting of a new set of specifications. He suggested it might be appropriate to reconvene the Task Force to review these factors at that time.

LAKIN commented that as this recommendation does go forward to the City Commission, staff has an obligation to present the report to the Economic Development Commission which replaced the old Real Estate Advisory Commission, which jointly had this assignment with the Planning Commission. He stated staff will be presenting it to that Commission prior to it appearing on the City Commission agenda.

> MOTION: That the Planning Commission approve the report, forward it to the City Commission with the recommendation that it be implemented as rapidly as possible. Wilson moved, Chisholm seconded.

GARDNER asked if the motion included the recommendation regarding the drafting of a new set of installatio specifications.

WILSON asked if that was in the report. GARDNER said yes. WILSON said that then he does not have to say that specifically, does he? GARDNER agreed that Wilson was right. WILSON further stated that if the Commission accepts the report, they accept what is in the report.

VOTE ON THE MOTION: It carried unanimously. Jones, Lofton and Parson were absent.

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11. City of Wichita, 1983-88 Capital Improvement Program Schedule and opportunity to request initiation of specific projects.

LAKIN stated that it was that time of year again when they begin to prepare and update the existing CIP. He said that he only had the schedule available when the agenda was mailed. Since then he received the handout that was passed to the Commission, which contains two additional items; the City Manager's general guidelines for the preparation of the CIP; and blank forms to submit when they put projects together. He said that the same rating and weighting systems that they used last year would be used this year. He said that he would expect that if this schedule was to be followed there would be some sort of preliminary package available around the first of October. The Commission could then sit down at a work session and at least know what new projects are proposed and how the Administrative Committee may be looking at the projects. LAKIN said that he needed to know if there were any projects that anyone wanted to submit, and whether or not the Commission, as a whole, would like to review it. He said that his assessment of the CIP proogram this year was that they were not going to see too many changes in the priority of the projects, because last year's program was largely devoted to designing projects and acquiring right-of-way and most of them would go to contract this year. If there are other projects that should be added, it would require adding more money as well as making hard decisions on which ones to put aside.

GARDNER wondered if it would be appropriate, that during the month of September there would be a presentation of the Engineering status report as to the status of projects, overall progress, where they are versus where they want to be, and how much of that would carry over to the following year.

LAKIN said that the Commission was aware that Engineering was doing a status report and it is due shortly.

WILSON said that the form was still being worked on, and he wondered how Engineering would give them the report.

LAKIN stated that the form has been revised each quarter. He was not sure how the Commission would view it, but he was finding it to be a better form, and that now he could determine what has happened since the last one without having to do a complete bookkeeping system with some of the notations. He

August 30, 1982

Metropolitan Area Planning Commission

Robert A. Lakin, Director of Planning

DR 82-23 - Presentation of Cost-Effectiveness Study of Sewer Pipe Materials

In December of last year, the Board of City Commissioners directed the Metropolitan Area Planning Commission to proceed with a study of different storm sewer pipe materials. On December 10, 1981, Chairman Gardner appointed a Task Force to identify the issues surrounding the cost-effectiveness of alternate materials. The Task Force consisted of the following persons:

1. George Wilton - Chairman
2. Chris Breitenstein - Drainage Engineer, City of Wichita
3. Charles Freund - Professional Engineering Consultants, P.A.
4. Max Hubbell - Campbell and Castle Engineers, P.A.
5. M. S. Mitchell - Private Consultant
6. Bill Otten - Chief Water Engineer, City of Wichita
7. I. L. Penner - Private Consultant
8. Don Schneider - Sanitary Sewer Engineer, City of Wichita
9. Mike Thompson - Poe and Associates, P.A.

The Task Force was organized into sub-committees to study four major subject areas. These subject areas were as follows:

- Hydraulic equivalence
- Service life
- Installation specifications
- Maintenance

Seven open meetings, for which public notice was given, were held. It was at those meetings that the different material suppliers were provided the opportunity to express their views and make information available to the Task Force.

Attached is the report of the Task Force. The major outcomes discussed in the study include:

- A recommendation for hydraulic "N" valves which more correctly reflect flow conditions in the field.

- A recommendation that the minimum allowable thickness of corrugated steel pipe be established at 0.109 inches or 12 gauge in order to increase its predicted service life.

- A recommendation that smooth flow bituminous coatings and pavings in corrugated steel pipe no longer be permitted, because of insufficient durability.

- A recommendation that the City of Wichita's installation specifications for storm and sanitary sewer be rewritten in order to be more clear and less open-ended.

- A recommendation that storm sewer pipe materials currently not being used by the City be specified for test installation.

This report is placed on your agenda for purposes of obtaining the Commission's inputs, comments and recommendations on the report prior to it being scheduled for review by the Board of City Commissioners. The report will also be reviewed by the Economic Development Commission prior to City Commission consideration.

Several years ago, a similar-type study on street pavement was completed. That study proposed specific design standards which were implemented by City ordinance. That approach to implementation is not as applicable in this instance in that several items need to be detailed as a part of specification writing. If the Metropolitan Area Planning Commission concurs with the Task Force findings, it should be recommended to the Board of City Commissioners to direct the Director of Engineering to proceed to implement those policy recommendations which can be immediately implemented. For those recommendations which require more time to implement, you may wish to consider recommending that the Engineering staff submit a status report, after six months, which outlines the progress made toward implemention of those recommendations. At that time, the status report could be reviewed by both this Commission and a reconvened Task Force.

Robert A. Lakin
Director of Planning

RAL:FLN:bh

Attach.

cc: Task Force on Storm Sewer Pipe Materials
R. W. Bruggeman, P.E., Director of Engineering
Darwin L. Christensen, P.E. Kaiser Aluminum
Donald E. Doerhoefer, Spiral Engineered Systems
Clinton Dunn, P. E., J. and J. Metal Products
Merl D. Francis, Big R Manufacturing and Distributing, Inc.
Don Gibbs, Millcon Corporation
Robert L. Meinzer, P. E., ARMCO, Inc.
Tom Nearn, P.E., Kaiser Aluminum

Bob Reinke, ARMCO, Inc.
Mike Rice, J and J Metal Products, Inc.
Thomas E. Selders, Big R Manufacturing and Distributing, Inc.
John Wesselhoff, P.E., National Corrugated Steel Pipe Association
Darrell R. Brewer, Jr., Superintendent of Sewer Maintenance
John D. Wynkoop, Director of Water and Water Pollution Control

August 31, 1982

Task Force on Storm Sewer Pipe Materials - INSERTS (9)

Forrest L. Nagley, Junior Planner

Updating inserts for Cost-Effectiveness Study on Storm Sewer Pipe Materials

Attached please find the corrections and changes made in the above-referenced report at the July 29, 1982 meeting of the Storm Sewer Pipe Task Force. Those pages being replaced by the inserts should be discarded. For those persons receiving a copy of this memorandum who do not have a copy of the study to update, a corrected copy is herewith attached.

The Cost-Effectiveness Study has been scheduled for review by the Metropolitan Area Planning Commission at their next regular meeting on Thursday, September 9, 1982. The meeting will begin at 1:30 p.m. in the City Commission Chambers, 1st floor, City Hall, 455 N. Main. Review of the report will be item number 10 on the agenda. An agenda is attached for your reference.

Also attached is Mr. Lakin's memorandum to the Planning Commission regarding their consideration of this agenda item. Should anyone have any questions about this report or its scheduling before the Planning Commission, please call me at (316) 268-4421.

Forrest L. Nagley
Junior Planner

FLN:bh
Attachments (3)

cc: R. W. Bruggeman, P.E., Director of Engineering INSERTS
Darwin L. Christensen, P.E., Kaiser Aluminum INSERTS
Donald E. Doerhoefer, Spiral Engineered Systems FULL RPT.
Clinton Dunn, P.E., J and J Metal Products FULL RPT.
Merl D. Francis, Big R Manufacturing & Distributing, Inc. FULL RPT.
Don Gibbs, Millcon Corporation INSERTS
Robert L. Meinser, P.E., ARMCO, Inc. INSERTS
Tom Nearn, P.E., Kaiser Aluminum FULL RPT.
Bob Reinke, ARMCO, Inc. INSERTS
Mike Rice, J and J Metal Products, Inc. INSERTS
Thomas E. Selders, Big R Manufacturing and Distributing, Inc. FULL RPT.
John Wesselhoff, P.E., National Corrugated Steel Pipe Association F. RPT.
Darrell R. Brewer, Jr., Superintendent of Sewer Maintenance F. RPT.
John D. Wynkoop, Director of Water and Water Pollution Control F. RPT.
Phil Dietrich, Senior Civil Engineer, Sedgwick County Department of Public Works F. RPT.
Joel Pollack, Chairman, Economic Development Commission INSERTS
Douglas Hahn, Phd., Sedgwick County Department of Environmental Resources INSERTS
Dave Flory, Wichita, Kansas F. RPT.

WICHITA-SEDGWICK COUNTY
METROPOLITAN AREA PLANNING COMMISSION

AND THE

ECONOMIC DEVELOPMENT COMMISSION

Cost-Effectiveness Study on Storm Sewer Pipe Materials

Submitted by:

Task Force
on
Storm Sewer Pipe Materials

TO Economic Development Commission
Metropolitan Area Planning Commission

FROM Task Force on Storm Sewer Pipe

The attached report constitutes not only the efforts of the Members of the Task Force, but of City and County staff members, various suppliers of pipe materials and the faithful members of the audience who participated in the numerous, and on occasion, lengthy meetings. The report will not please all parties, but the Task Force believes that it is a good conservative approach to providing equality between corrugated steel storm sewer pipe and concrete storm sewer pipe based on information and experience available. It is unfortunate that some other types of available materials have not been used in controlled situations so that local experience could be gained. To this end, the Task Force recommends that some test installations be made in order to get some first-hand experience where the available information indicates that other materials have merit. Some of those materials are discussed briefly in this Report.

When the Task Force was appointed, it was asked to study and report on four sub-elements. Those four, Hydraulic Equivalence, Service Life, Installation Specifications, and Maintenance, were studied and debated at considerable length, and the report transmitted herewith distills that study. Careful comparison of the charge given the Task Force with respect to installation specifications and this report will reveal that although considerable material was considered by the Task Force, it became apparent to its members that a major rewriting of the City of Wichita specifications for installation of storm water sewers, to account for flexible pipe systems, is beyond the capabilities of the Task Force. Most of the Task Force discussion on specifications took place without benefit of review of revisions to the "Specifications For Sanitary and Storm Sewers" which are dated March 1982, but due to printing delays, were not available to the Task Force until May. The changes included in that edition do not separate the methods to be used to install or specify the performance expected from the rigid and flexible systems and are somewhat ambiguous as to what applies to storm sewers and what applies to sanitary sewers. Most of the Task Force members have experience in writing and assembling specifications for public contracts and feel that the questions raised during the Task Force study can only be answered by a major rewriting and that such an undertaking should be by a consultant who is experienced with pipe laying work in Wichita; who has access to technical experts in several fields; has access to legal review of the work, and finally, has experience in developing and keeping up-to-date technical specifications for storm water sewers.

ACKNOWLEDGEMENTS

The Task Force wishes to thank the following individuals for their cooperation and participation in the study, and in particular, for furnishing data and information which contributed to the conclusions and recommendations reached in this study.

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John D. Wynkoop, Director of Water & Water Pollution Control

GLOSSARY

AASHTO.....	American Association of State Highway and Transportation Officials.
Annular Pipe.....	Where the Corrugations Run Annularly Around the Pipe.
APWA.....	American Public Works Association.
ASCE.....	American Society of Civil Engineers.
Bedding.....	Material on Which the Pipe is Supported.
CAP.....	Corrugated Aluminum Pipe.
CMP.....	Corrugated Metal Pipe.
CSP.....	Corrugated Steel Pipe.
Deflection Limit.....	Maximum Allowable Decrease in Diameter or Rise of Sewer Pipe, Including Allowable Manufacturers Tolerance.
Flushing.....	Flooding of the Backfill With Water to Secure Settlement.
Helical Pipe.....	Where the Corrugations and Seams Run Helically Around the Pipe.
Jetting.....	The Use of Water to Secure Settlement of the Backfill by Introducing Water Through Jets Beginning With the Lower Extremities of the Fill.
Load Factor.....	The Ratio of the Supporting Strength in an Actual Field Installation to the Strength as Determined in the Laboratory by Means of a Three-edge Bearing Test.
N or n.....	A Roughness Coefficient in the Manning Formula Representing the Effect of Pipe Roughness on Energy Losses in the Flow.
Plain Corrugated Steel Pipe.....	Where Only a Zinc or Galvanized Coating Has Been Applied.
RCP.....	Reinforced Concrete Pipe.
Reformed Ends.....	Where the Ends of Helically Corrugated Pipe Have Been Reformed to Annular Corrugations.
Service Life.....	The Length of Time that A Storm Sewer System Should Function Without Major Repair.
Test Installation.....	A Limited Installation of Storm Sewer Pipe for the Purpose of Studying its Hydraulic Capabilities, Service Life, Installation Problems, or Costs Under Varying Conditions. The Length of the Installation Should be Sufficient to Evaluate as a Storm Sewer, and Not as an Inlet Lead, and Should Begin and End at Manholes or Terminate at the Outfall End of the Line.

I INTRODUCTION

A. Responsibility of the Task Force

The Task Force was appointed by the Board of Land Use Economics and the Metropolitan Area Planning Commission, to study the cost-effectiveness of different types of pipe material available for use in the construction of storm sewers in the City of Wichita. To this end, the following four sub-elements were identified:

1. Hydraulic Equivalence - A comparison of capacities of various sizes of steel and concrete pipe under various installation conditions, coatings, and linings.

2. Service Life - A collection of data showing expected and/or actual service life of concrete and steel pipe.

3. Installation Specifications - A comparison of the installation requirements for concrete and steel pipe including load-carrying capacities and estimated costs.

4. Maintenance - A comparison of the various maintenance problems and costs associated with the two types of pipe.

The Task Force was organized into study groups in order to individually study these sub-elements or issues.

Representatives of the manufacturers of several different types of pipe were provided the opportunity to address the Task Force as a whole on each of the sub-elements and to furnish any information they deemed pertinent to the study. In addition, product manufacturers addressed

costs should be charged to the project as is now the case with sanitary sewers.

2. The design of storm sewers should provide for a minimum cleansing velocity of 2 (fps) at a depth of 0.2 of the diameter or rise of the pipe.

3. Training seminars for construction inspectors should be initiated, possibly through the American Public Works Association, but with major training contributions by representatives of the various manufacturers of pipe materials used by the City. These training seminars should also be attended by design engineers, but more advanced courses in design should be made available to them.

4. Bedding and backfill specifications were improved during the Task Force study period. However, they need to be improved where corrugated steel pipe is used to require complete sand or gravel encasement, thereby providing protection against external corrosion as is now the practice in water line installations. The standard detail shown on page 39 of the City of Wichita Proposals and Specifications for Sanitary and Storm Sewers, should be revised to require the compacted granular material to be brought to a point 12 inches above the top of pipe and the heading revised to read "Detail of Improved Bedding For PVC and Corrugated Steel Pipe." The heading for the detail on page 37, will have to be revised to include Corrugated Steel Pipe as one of the exceptions.

5. The specifications should include a deflection limit of five percent of the nominal diameter of corrugated steel pipe. A deflection greater than 5 percent should result in the contractor reconstructing that section of line.

6. The use of jetting or flushing should not be allowed for compaction of backfill on corrugated steel pipe installations. Only hand or mechanical tamping of backfill placed in layers should be allowed.

7. Although the Task Force was assured that corrugated steel pipe can be furnished in any size in one-inch increments, a problem could arise in securing the proper size for making a repair or an extension if other than standard sizes are specified. The Task Force, therefore, recommends that only standard sizes be specified.

8. The Task Force recommends that storm sewer pipe, of materials other than those currently in use by the City, be specified for test installations of 300-600 feet where research indicates that the material has merit. The test installations could be a selected part of a project where the effects on the overall project were negligible. It is not the intent of this recommendation to restrict the study of the new material to one installation, but to encourage installations under varying conditions, so that an accurate and complete evaluation can be made.

9. In order to help in the fight against corrosion, the ungalvanized welds and pipe ends should be factory painted and any areas where the galvanizing has been damaged in shipping or installation should be field-painted.

10. The Task Force recommends that gaskets be specified with hugger bands on all corrugated steel pipe joints to insure a proper and water-tight joint.

11. In order to make the service life of corrugated steel acceptable, the minimum allowable thickness should be established at 0.109 inches or 12 gauge.

12. The Task Force does not believe that the bituminous coatings and paving are accomplishing the purposes for which they have been specified; therefore, it is recommended that they no longer be permitted.

13. That a program of routine inspection of corrugated steel pipe storm sewers and test installations of other materials be initiated to provide a record on which to base future changes in sewer maintenance policy or construction material specifications. The inspections should be made by teams consisting of members from the Sewer Maintenance Division and the Engineering Department.

14. That the Task Force, after a reasonable period in which to implement the recommendations, be reconvened to determine, if, in fact, the recommendations have been implemented and are working as anticipated by the Task Force.

15. That the specifications for storm and sanitary sewers be rewritten to spell out in more detail that which the contractor is expected to do, and the results which he is expected to obtain and in the process, the specifications for storm and sanitary sewers be separated to eliminate the confusion which now exists in determining which parts are applicable to each kind of sewer. The Task Force further recommends,

that separate specifications be written for rigid and for flexible pipe.

16. That the Manning's Friction Factors (n) shown in the Appendix be adopted.

III HYDRAULIC EQUIVALENCE

Since velocities for storm water sewers are based on Manning's Formula ($V = \frac{1.49}{n} R^{2/3} S^{1/2}$), which is universally accepted by most governmental agencies, municipalities, and consultants, it is then apparent that the coefficient of roughness, or Manning's "n", will determine the capacity of any storm sewer with a given diameter, slope and flowing full.

Values of Manning's "n" were studied in numerous textbooks, handbooks produced by affected associations and from studies prepared by nearby municipalities. Values utilized by the Kansas Department of Transportation and those currently being used by the City of Wichita were also reviewed. It was determined that in the area of normal practicality, there was little variation in values used or proposed.

The values currently under use by the City of Wichita were found to be acceptable, but are, perhaps too refined for the usual degree of accuracy expected from normal hydrology and hydraulic equations. The Task Force did, however, question the coefficients assigned helical pipe and proposes modified values to reflect the Task Force's thinking.

Although the Task Force attempted to pursue a course which would permit alternate materials to be specified on the basis of only one design--which is the current practice--it soon became evident that this would not be possible. This is because, if the alternate materials have a wide difference in roughness coefficients, there will be a marked effect on velocities at the same slope. There can also be a problem with the physical installation of a larger pipe of equivalent

capacity because of lack of cover or interference with other utilities. Even though it is possible to prepare simple graphs showing pipe sizes for equivalent capacities, as have been included in the Appendix, the designer must check physical considerations and velocities to be sure that clearances are there for a larger pipe and minimum velocity is maintained. It will be necessary, in most cases, to make two designs if alternate pipe materials are to be specified.

The Task Force, after reviewing available literature and television tapes of existing sewer installations, is of the opinion that in order to avoid--as much as possible--the collection of silt and debris in the lines, a minimum cleansing velocity of 2fps at a depth of 0.2-full, should be adopted.

IV SERVICE LIFE

The first step to be taken during a discussion of Service Life, is to define the expression "Service Life." Based on the Task Force's study of numerous reports, letters, pictures and books, the following definition of Service Life was derived: "The length of time that a storm sewer system should function without major repairs or replacement."

The next step is to determine the minimum service life for which a storm sewer should be designed: A 1971 study by the Research Division of the Department of Planning and Development of the State of Kansas, concluded that a life of 40 to 50 years or more may be anticipated for normal galvanized steel pipe culverts in Kansas. This anticipated service life was applicable to most locations in Kansas except those near active coal mines. A majority of the pipes in this study were 16 gauge and 24 inches or less in diameter. A 1973 survey of 14 cities in the southeastern United States indicated that 71 percent of the surveyed cities accepted a 50-year use for a storm sewer. The Handbook of Steel Drainage and Highway Construction Products, estimates years to perforation of the invert of 16-gauge plain galvanized corrugated steel pipe in normal water (pH $\geq$ 5.8) to be 49 years. The Sewer Manual for Corrugated Steel Pipe, by the National Corrugated Steel Pipe Association, references a study conducted by the Los Angeles County Flood Control District, on CSP storm drains, which concluded that the crown zone of CSP could be assigned a service life of 100 years, provided an exterior coating was applied. The 1958 Edition of the Concrete Pipe Handbook, prepared by the American Concrete Pipe Association (ACPA), states that the universally accepted

partment of Highways report that the service life of asbestos bonded fully paved and coated corrugated metal pipe can be extended at least 25 years over the plain galvanized pipe. The Ohio Department of Transportation states that asbestos bonded bituminous coating and paving has performed very well and seems to have corrected the problem of adherence of bituminous protection. A report in 1976 by the Battelle Columbus Laboratories of Columbus, Ohio, stated that all of the asbestos bonded pipes with 35-36 years of service were reported to be in "very satisfactory condition". and the coating was reported to be "intact" or "like new." Asbestos bonding is a coating system which has been around a long time, is very dependable--according to the above sources--but apparently has never been used here.

Another way the Task Force believes corrugated steel pipe can be made a more equal storm sewer material, is to increase the base metal thickness. The American Iron and Steel Institute uses a corrosion-abrasion rate of 0.0013 inches per year for normal conditions (pH $\geq$ 5.8). At that rate, it would take 84 years to perforate a wall thickness of .109 inches (12 gauge). The Task Force is of the opinion that increasing the thickness of the base metal is a more positive way to predict the service life of the corrugated steel pipe than is the use of asbestos bonded bituminous coatings.

During the study of service life, data became available on corrugated steel pipe with an aluminized coating rather than a galvanized coating, corrugated aluminum pipe and "Spriolite", a high-density polyethylene pipe. Presentations were made by representatives of the manufacturers of these three products and literature was obtained.

V INSTALLATION SPECIFICATIONS

Obviously those who were involved in the decision to permit the use of corrugated steel pipe as an alternate material for use in the construction of storm sewers, envisioned construction of corrugated steel pipe storm sewer systems with comparable quality of construction, hydraulic efficiency and service life to that which was known to be attainable with concrete pipe. Representatives of the corrugated steel pipe industry provided much information to those involved with making this decision. They gave testament to a high quality type construction of storm sewer systems utilizing corrugated steel pipe. However, photographs recently reviewed by this Task Force indicate that the quality type of corrugated steel pipe storm sewer systems envisioned by those responsible for making the decision to permit use of this material as an alternative to concrete pipe is <u>not</u> being attained. Recent photographs also viewed by this Task Force seems to indicate many like problems with concrete pipe storm sewers. The old cliche "the proof of the pudding is in the eating thereof", appears to be applicable in this situation. The "pudding" has now been tasted and the flavor appears to be less than the quality desired. The question now which appears before this Task Force is whether or not the "recipe" can be upgraded to produce the quality of "flavor" desired in the "pudding". This document will address installation specifications as one aspect of the "receipe" for quality storm sewer construction.

An understanding of the environment within which the specification writer must function is necessary prior to passing judgement on the adequacy of written specifications. Some

corrugated steel storm sewer the Task Force feels is necessary to afford protection in corrosive soils. The designer should note, however, that as the City standard bedding requirements are now written, a load factor of 1.5 is provided. Special site conditions dictate variations in construction methods. The designer is responsible for specifing a higher class bedding or specifying a stronger conduit in situations where the standard specifications are not adequate to cover a special condition on a project.

4. A deflection limit on flexible pipe. Flexible conduits depend on deflection of the pipe to transfer loads on the pipe to the passive soil resistance of the backfill. Technical literature indicates that long term deflection may exceed initial deflection by as much as 24 to 50 percent. This continued deflection will lead to pipe failure and can, in most cases, be attributable to excessive deflection existing when the project was completed. With this in mind, it would seem appropriate to establish a limit for initial deflection. Technical literature concerning flexible conduits seem to uniformly recommend an initial deflection limit of five percent.

5. Compaction method for flexible pipe. The use of jetting or flushing for compaction in the installation of flexible pipe seems in the least to be a risky procedure, because it is most difficult to obtain equal compaction around the pipe. Where proper compaction is so vital to the structural integrity of the flexible pipe installation, it should be done with suitable material in layers, using hand and mechanical tampers.

Inspection of several of the fully paved steel pipe storm water sewers installed in Wichita as early as 1973, and as late as 1981, revealed problems with the paving similar to the problems of the coatings and pavings of the Flood Control culverts. Detached, loosened or badly checked pavings were found at the outlet of all sewers inspected and the pattern of checking or cracking, especially near the bottom, was not limited to the outlet, as was suggested during Task Force meetings. Inspections also found several steel storm water sewers with considerable deposits on the floor of the pipe which prevented appraisal of the condition of a portion of the paving.

On April 23, 1982, the Sewer Maintenance Division attempted to clean three to four inches of deposit from the bottom of 390 feet of 48 inch diameter fully paved storm water sewer prior to making a TV inspection of the line. Most manhole openings in the line are less than 20 inches in diameter making a 15 inch diameter drag bucket complete with side bails the largest equipment that would pass through the manhole openings. As a consequence, the 15 inch drag bucket was able to make only a small opening in the center of the deposit on the floor of the 48 inch pipe. The TV inspection of the line following dragging was not successful because the camera illumination was absorbed by the black pipe interior and it was not possible to obtain sufficient contrast to analyze the video image. Although the TV inspection was not able to detect any damage to the paving, at least one rib of the drag bucket was coated with bitumin following the dragging operation. Some method for the removal of these deposits must be developed if the full design capacity of these sewers is to be restored. Other problems, such as the infiltration of backfill at joints also present unique problems in repairing paved steel storm

RECOMMENDED MANNINGS FRICTION FACTORS

Reinforced Concrete Pipe	
All Sizes	n = 0.013
Corrugated Metal Pipe	
2-2/3" x 1/2" helical and circumferential corrugations	n = 0.024
3" x 1" helical and circumferential corrugations	n = 0.027

E. Storm Water Sewer Maintenance Tools, Equipment and Practices

1. Portable, engine driven rod turning machine; steel sectional rods and augers. These tools are used on short sections on small diameter sewers to open blockages caused by roots, limbs, boards, sticks and rocks. A crew of three is usually required for augering.

2. Trailer mounted, engine driven, continuous steel rod rodding machine with springblade root knife, used on small diameter (up to 18") sewers to cut roots. A crew of two is usually required for knifing.

3. Truck mounted water supply tank and PTO driven medium pressure water pump with self propelling (creeper) nozzle used on culverts and short sections of sewer to flush out deposits. The nozzle propels itself and its water supply hose (usually fire hose) into the line and flushes out deposits as it is being manually retrieved. Where available, a fire hydrant can be used to supply water pressure and volume. Crew size depends on method of loading deposits and water supply.

4. High pressure water jet cleaner mounted on vacuum loading truck equipped with water supply tank. The jet cleaner is equipped with as much as 600 feet of small diameter, smooth coated hose which is jet propelled into the sewer; then hydraulically retrieved to flush deposits to the vacuum loading nozzle. The deposits are loaded into a large

7. Closed circuit television camera and light source mounted on skids for a 15 inch diameter pipe. The camera is pulled through a sewer pipe by cable winch and sends a video signal to the monitor located inside the van control booth. TV inspection is the only method of determining the condition of small diameter (up to 36") pipe. Photographs of the TV image are used to improve the usability of written logs of TV inspections and when coupled with a videotape recorder can provide a permanent record.

8. TV inspection and chemical grout control booth which contains two-way communications speaker and headphones, TV monitor, videotape recorder, and controls for chemical grouting equipment.

9. Chemical grout pump takes proper amount of chemical from each of two tanks and pushes the chemicals through separate hoses to the grout packer.

10. Chemical grout crack and joint sealing packer in tandem with TV camera. When a cracked pipe or open joint between pipes appears on the TV monitor, the operator can position the packer over the area to be repaired, inflate a sleeve at each end of the packer with compressed air and pump the two-part chemical grout into the cavity. Upon contact, the chemicals combine to form an acrylic plastic seal in the void. The sleeves are deflated, the packer moved away from the grout and the repair is inspected

PIPE SIZING FOR EQUIVALENT CAPACITY BASED ON MANNINGS EQUATION FOR CIRCULAR PIPES FLOWING FULL

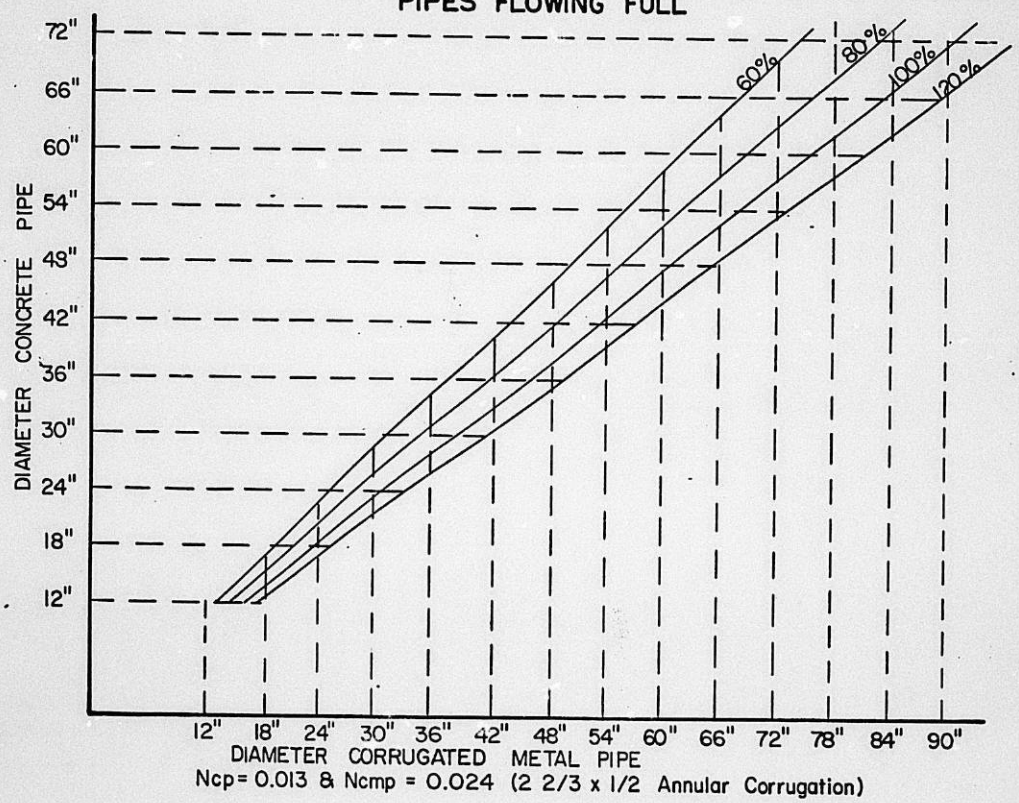


FIGURE 1

VII-2

PIPE SIZING FOR EQUIVALENT CAPACITY BASED ON MANNINGS EQUATION FOR CIRCULAR PIPES FLOWING FULL

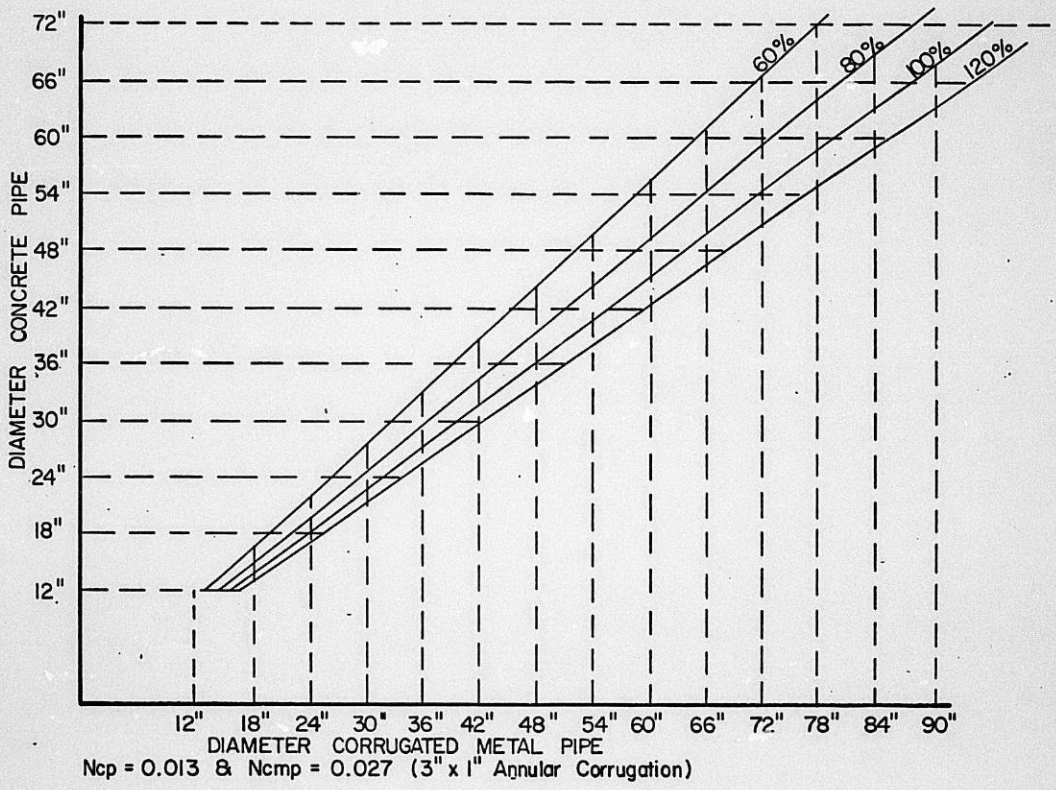
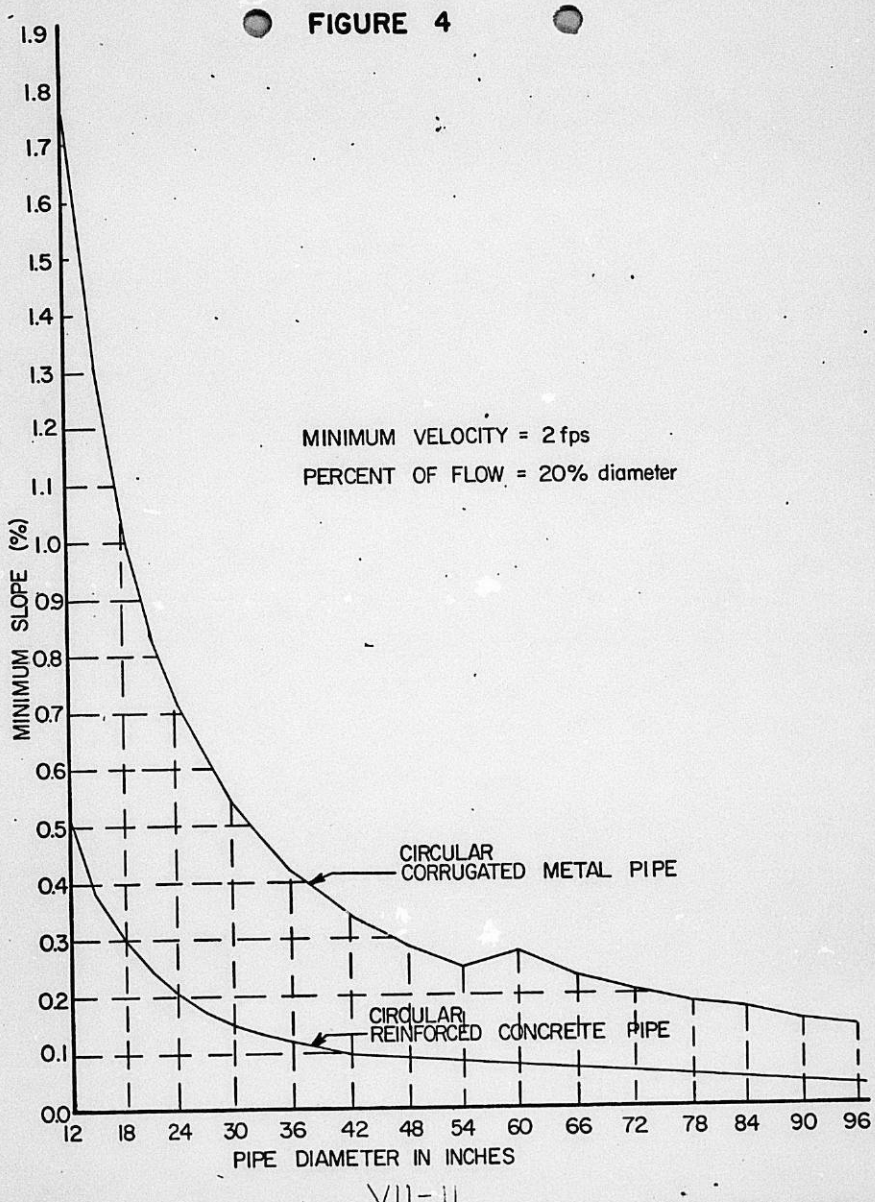


FIGURE 2

FIGURE 4


MINIMUM SLOPE (%)
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
12 18 24 30 36 42 48 54 60 66 72 78 84 90 96
PIPE DIAMETER IN INCHES
MINIMUM VELOCITY = 2 fps
PERCENT OF FLOW = 20% diameter
CIRCULAR CORRUGATED METAL PIPE
CIRCULAR REINFORCED CONCRETE PIPE

August 31, 1982

Consulting Engineers

Forrest L. Nagley, Junior Planner

Metropolitan Area Planning Commission Review of Cost-Effectiveness Study on Storm Sewer Pipe Materials - DR 82-23

As many of you are aware, over the last eight months, a Task Force of local engineers has been studying the cost-effectiveness of different storm sewer pipe materials. The Task Force has recently completed their study and the report will be reviewed by the Metropolitan Area Planning Commission on Thursday, September 9, 1982. The meeting will begin at 1:30 p.m. in the City Commission Chambers, 1st floor, City Hall, 455 N. Main. Review of the report will be item number 10 on the agenda. An agenda and a copy of Mr. Lakin's memorandum to the Planning Commission regarding their consideration of this agenda item are attached for your information and reference.

Should any of you have any questions about the Cost-Effectiveness Study, or its scheduling before the Metropolitan Area Planning Commission, please call me at 268-4421. I have a very limited number of copies of the study. I would be happy to loan a copy to any of you interested in reviewing the document in detail prior to the Planning Commission presentation.

Forrest L. Nagley
Junior Planner

FLN:bh

Attachment

cc: Ken Bengston, P.E., Van Doren-Hazard-Stallings
R. Chandler, P.E., Wilson and Company
C. Goodness, P.E., Reiss and Goodness
Don Moehring, P.E., Moehring and Associates
W. Freund, P.E., Booker and Freund Associates
O. Daniels, P.E., Engineering Testing Company
Bob Friesen , P.E., The Law Company
F. Roedell, P.E., B. E. and C. Engineers
D. Winfrey, P.E., Winfrey Engineering Services
Brent Wooten, P.E., Baughman Company
William Keltner, P.E., Allied Laboratories

September 1, 1982

Interested individuals and organizations

Forrest L. Nagley, Junior Planner

Metropolitan Area Planning Commission review of Cost-Effectiveness Study on Storm Sewer Pipe Materials - DR 82-23.

Over the last nine months you have been receiving the meeting notice and agenda for the meetings of the Task Force on storm sewer pipe materials. The Task Force has completed their study and the report will be considered by the Planning Commission on Thursday, September 9, 1982. The meeting will begin at 1:30 p.m., in the City Commission Chambers, 1st floor, City Hall, 455 N. Main. Review of the report will be item number 10 on the agenda. An agenda and a copy of Mr. Lakin's memorandum to the Planning Commission regarding their consideration of this matter are attached for your information and reference.

Should any of you have any questions about the Cost-Effectiveness Study or its scheduling before the Metropolitan Area Planning Commission, please call me at 268-4421.

Forrest L. Nagley
Junior Planner

FLN:bh

Attachments

cc: Tracy Burton, Wichita, Kansas
Stephen Clark, Clark Realtors
Anita Frey, Frey Realtors
Tom Ritchie, Ritchie Paving
Larry Martin, Mid-Kansas Construction Co., Inc.
George Tomlin, Major, Inc.
Lowell Richardson, Mid-Kansas Federal Savings and Loan
David Stowe, Director, Operations and Maintenance
Karl Kennedy, Industrial Development

Russell Brenner, Director of Administration
John Dekker, Law Department
William Rustin, County Counselor
Tom Powell, Law Department
Wichita Metropolitan Area Board of Realtors, Inc.
Wichita Area Builders Association

THESE persons & organizations were notified of M.A.P.C. review by attaching Lakin's memo to their M.A.P.C. agenda:

1. Earl T. Graves
2. Jay Setter
3. Wichita Metro. Area Bd. of Realtors
4. Wichita Area Builders Assoc.
5. City P.I.O.
6. County P.I.O.
7. Don Anderson
8. C.P.O. office

FCN
9/1/82

9/1/82 memo to "interested individuals and organizations" was also sent with agenda & Lakin memo to:

1. Wichita Metro. Area Bd of Realtors
2. Wichita Area Builders Assoc.

FCN
9/1/82

* = TASK FORCE MEMBER (PLEASE PROVIDE MINUTES WITH AGENDA)

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Sent to Jay Scott with M.A.P.C. agenda

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Co. copy sent to Dietrich (inserts)

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Stanley — Public Information - County (10 copies)
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Stanley — Don Anderson, Housing & Economic Dev.-#4631
10 Russell Brenner, Administration- #4434
11 John Dekker, Law - #4681
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12 William Rustin, County Counselor -#7111
13 Tom Powell, Law - #4681

11/30/81

32

WICHITA-SEDGWICK COUNTY
METROPOLITAN AREA PLANNING COMMISSION
AND THE
ECONOMIC DEVELOPMENT COMMISSION

Cost-Effectiveness Study on Storm Sewer Pipe Materials

July 29, 1982

Submitted by:

Task Force
on
Storm Sewer Pipe Materials

TABLE OF CONTENTS

TO Economic Development Commission
Metropolitan Area Planning Commission

FROM Task Force on Storm Sewer Pipe

The attached report constitutes not only the efforts of the Members of the Task Force, but of City and County staff members, various suppliers of pipe materials and the faithful members of the audience who participated in the numerous, and on occasion, lengthy meetings. The report will not please all parties, but the Task Force believes that it is a good conservative approach to providing equality between corrugated steel storm sewer pipe and concrete storm sewer pipe based on information and experience available. It is unfortunate that some other types of available materials have not been used in controlled situations so that local experience could be gained. To this end, the Task Force recommends that some test installations be made in order to get some first-hand experience where the available information indicates that other materials have merit. Some of those materials are discussed briefly in this Report.

When the Task Force was appointed, it was asked to study and report on four sub-elements. Those four, Hydraulic Equivalence, Service Life, Installation Specifications, and Maintenance, were studied and debated at considerable length, and the report transmitted herewith distills that study. Careful comparison of the charge given the Task Force with respect to installation specifications and this report will reveal that although considerable material was considered by the Task Force, it became apparent to its members that a major rewriting of the City of Wichita specifications for installation of storm water sewers, to account for flexible pipe systems, is beyond the capabilities of the Task Force. Most of the Task Force discussion on specifications took place without benefit of review of revisions to the "Specifications For Sanitary and Storm Sewers" which are dated March 1982, but due to printing delays, were not available to the Task Force until May. The changes included in that edition do not separate the methods to be used to install or specify the performance expected from the rigid and flexible systems and are somewhat ambiguous as to what applies to storm sewers and what applies to sanitary sewers. Most of the Task Force members have experience in writing and assembling specifications for public contracts and feel that the questions raised during the Task Force study can only be answered by a major rewriting and that such an undertaking should be by a consultant who is experienced with pipe laying work in Wichita; who has access to technical experts in several fields; has access to legal review of the work, and finally, has experience in developing and keeping up-to-date technical specifications for storm water sewers.

The Task Force feels that it should be reconvened after sufficient time has elapsed in which to put into effect those recommendations which are ultimately adopted and/or approved. In this way, a determination can be made of the results of the recommedations and if those results are those expected by the Task Force.

The Task Force wishes to thank the Economic Development Commission and the Metropolitan Area Planning Commission for the opportunity to serve the two Commissions.

George H. Wilton

George H. Wilton, P.E.
Task Force Chairman

GHW:vn
Attachment

ACKNOWLEDGEMENTS

The Task Force wishes to thank the following individuals for their cooperation and participation in the study, and in particular, for furnishing data and information which contributed to the conclusions and recommendations reached in this study.

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John D. Wynkoop, Director of Water & Water Pollution Control

The Task Force also wishes to thank the following organizations or firms for providing product information and representatives at meetings.

J and J Metal Products
National Corrugated Steel Pipe Association
J and J Drainage Products

COMMISSION REVIEW OF THE REPORT

Metropolitan Area Planning Commission
September 9, 1982

Economic Development Commission
September 23, 1982

Wichita Board of City Commissioners
October 12, 1982

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Max Hubbell, Consultant
M. S. Mitchell, Consultant
Forrest Nagley, Planning Staff, Ex Officio Member
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Don Schneider, P.E.
James M. Thompson, P.E.

GLOSSARY

AASHTO.....	American Association of State Highway and Transportation Officials.
Annular Pipe.....	Where the Corrugations Run Annularly Around the Pipe.
APWA.....	American Public Works Association.
ASCE.....	American Society of Civil Engineers.
Bedding.....	Material on Which the Pipe is Supported.
CAP.....	Corrugated Aluminum Pipe.
CMP.....	Corrugated Metal Pipe.
CSP.....	Corrugated Steel Pipe.
Deflection Limit.....	Maximum Allowable Decrease in Diameter or Rise of Sewer Pipe, Including Allowable Manufacturers Tolerance.
Flushing.....	Flooding of the Backfill With Water to Secure Settlement.
Helical Pipe.....	Where the Corrugations and Seams Run Helically Around the Pipe.
Jetting.....	The Use of Water to Secure Settlement of the Backfill by Introducing Water Through Jets Beginning With the Lower Extremities of the Fill.
Load Factor.....	The Ratio of the Supporting Strength in an Actual Field Installation to the Strength as Determined in the Laboratory by Means of a Three-edge Bearing Test.
N or n.....	A Roughness Coefficient in the Manning Formula Representing the Effect of Pipe Roughness on Energy Losses in the Flow.
Plain Corrugated Steel Pipe.....	Where Only a Zinc or Galvanized Coating Has Been Applied.
RCP.....	Reinforced Concrete Pipe.
Reformed Ends.....	Where the Ends of Helically Corrugated Pipe Have Been Reformed to Annular Corrugations.
Service Life.....	The Length of Time that A Storm Sewer System Should Function Without Major Repair.
Test Installation.....	A Limited Installation of Storm Sewer Pipe for the Purpose of Studying its Hydraulic Capabilities, Service Life, Installation Problems, or Costs Under Varying Conditions. The Length of the Installation Should be Sufficient to Evaluate as a Storm Sewer, and Not as an Inlet Lead, and Should Begin and End at Manholes or Terminate at the Outfall End of the Line.

I INTRODUCTION

A. Responsibility of the Task Force

The Task Force was appointed by the Board of Land Use Economics and the Metropolitan Area Planning Commission, to study the cost-effectiveness of different types of pipe material available for use in the construction of storm sewers in the City of Wichita. To this end, the following four sub-elements were identified:

1. Hydraulic Equivalence - A comparison of capacities of various sizes of steel and concrete pipe under various installation conditions, coatings, and linings.

2. Service Life - A collection of data showing expected and/or actual service life of concrete and steel pipe.

3. Installation Specifications - A comparison of the installation requirements for concrete and steel pipe including load-carrying capacities and estimated costs.

4. Maintenance - A comparison of the various maintenance problems and costs associated with the two types of pipe.

The Task Force was organized into study groups in order to individually study these sub-elements or issues.

Representatives of the manufacturers of several different types of pipe were provided the opportunity to address the Task Force as a whole on each of the sub-elements and to furnish any information they deemed pertinent to the study. In addition, product manufacturers addressed

the individual study groups and provided them with more specific information relating to their sub-element assignments. The printed material provided is much too voluminous to include in this report, but we have filed a copy of the information submitted with the Planning Department. The Task Force has not hesitated to borrow from this material during the preparation of this report.

B. History of Storm Sewer Pipe Installations

Early storm sewer installations were vitrified clay tile up to 36 inches in diameter. Larger lines were constructed of brick or segmented tile in place. In a few cases brick was used for lines as small as 30 inches. These early lines have proven to be most durable with many still in service and only subject to replacement when major street reconstruction takes place.

The records indicate that the City began using concrete pipe in 1930. Some vitrified clay tile continued to be used into the early 1940s, mostly in catch basin leads.

Although the City had used corrugated steel pipe in culvert installations and for outfall lines into creeks for many years, it was not until 1972, that a storm sewer line of any length was constructed of corrugated steel pipe. There are no reliable records on the use of corrugated steel pipe for culvert and outfall installation inasmuch as most, if not all, were considered to be of a temporary nature. The exception being, those corrugated steel pipes used as part of the Wichita-Valley Center Flood Control Project.

City maintenance records indicate that 200 miles of storm sewer are currently being maintained. This inventory may not include some lines constructed as incidental drainage or by the State. The records do not reflect a breakdown by type of material, but a majority of the system is reinforced concrete pipe. In our study for this report we did verify the existence of about 12 miles of corrugated steel pipe.

II CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

1. Most information furnished to the Task Force regarding CSP has been based on analysis of culvert installations, not from studies of sewer installations.

2. The sizing of alternate pipe material can be accomplished using the chart included for such purposes provided checks are made to be certain minimum velocity and cover is maintained. In most cases, a separate and completely new design will be necessary.

3. Asphaltic coating on fully paved steel pipe is not of sufficient durability to warrant it's use for the purpose of a lower "N" value.

4. The use of lower "N" values for helically corrugated steel pipe is not deemed advisable, because the debris carried in the flow, the deposits in the pipe, and the interuptions to the flow caused by reformed pipe ends to make a joint and by manholes does not permit the ideal flow conditions necessary to make the lower "N" values applicable.

5. Asphaltic coating of steel pipe does not significantly extend the service life of the pipe.

6. The use of washed sand material as backfill around steel pipe will protect against external corrosion.

7. The service life of concrete and steel pipe can be made more nearly equal by specifying a thicker walled steel pipe than is required for strength alone.

8. Many of the problems discovered while examining various storm sewer installations could have been averted or corrected at the contractor's cost by more stringent enforcement of the contract documents.

9. Maintenance of ceramic and concrete pipe storm water sewers in Wichita has not required a major effort or expenditure to preserve the capacity for which they were designed and constructed.

10. The level of maintenance of the ceramic and concrete pipe storm water sewer system was adequate and appropriate, with rare exceptions, to protect and preserve the public investment in it.

11. The collection of dirt and other debris appears to be more prominent in the unpaved corrugated steel pipe than in the smooth concrete. Cleaning of the unpaved corrugated steel pipe will be required more frequently and such cleaning will pose more of a danger to the pipe itself.

12. Repair of construction related and encroachment damage to plain CSP storm water sewers will not lend itself to internal repair equipment or practices and probably will require excavation, removal of

the damaged portion and welding or banding a replacement section in place. Where the damaged CSP is beneath pavement and in an area of high utility line density, cost for traffic diversion, safety measures, pavement removal and replacement, shoring and support of exposed utilities will add to the cost of CSP repair.

13. Arriving at a comparison of different pipe materials on an annual cost effective basis was not deemed appropriate by the Task Force. It was decided the best approach was to provide for pipe materials which were as nearly equal as possible in terms of service life. Other factors can be taken care of by design and bids.

14. Providing for alternative pipe material for competitive purposes only can be, in the long run, a costly decision. Each and every pipe material can, at some time, be the best suited for a particular installation and should be specified. In those situations where alternate pipe material can be specified, the predicted service life of the alternates must be near equal.

B. Recommendations

1. Prior to final acceptance of a storm sewer project from the contractor a final check should be made of the completed project by personnel of the Sewer Maintenance Division for defects in the installation or materials using television for the smaller lines and by visual inspection for the larger lines. The

costs should be charged to the project as is now the case with sanitary sewers.

2. The design of storm sewers should provide for a minimum cleansing velocity of 2 (fps) at a depth of 0.2 of the diameter or rise of the pipe.

3. Training seminars for construction inspectors should be initiated, possibly through the American Public Works Association, but with major training contributions by representatives of the various manufacturers of pipe materials used by the City. These training seminars should also be attended by design engineers, but more advanced courses in design should be made available to them.

4. Bedding and backfill specifications were improved during the Task Force study period. However, they need to be improved where corrugated steel pipe is used to require complete sand or gravel encasement, thereby providing protection against external corrosion as is now the practice in water line installations. The standard detail shown on page 39 of the City of Wichita Proposals and Specifications for Sanitary and Storm Sewers, should be revised to require the compacted granular material to be brought to a point 12 inches above the top of pipe and the heading revised to read "Detail of Improved Bedding For PVC and Corrugated Steel Pipe." The heading for the detail on page 37, will have to be revised to include Corrugated Steel Pipe as one of the exceptions.

5. The specifications should include a deflection limit of five percent of the nominal diameter of corrugated steel pipe. A deflection greater than 5 percent should result in the contractor reconstructing that section of line.

6. The use of jetting or flushing should not be allowed for compaction of backfill on corrugated steel pipe installations. Only hand or mechanical tamping of backfill placed in layers should be allowed.

7. Although the Task Force was assured that corrugated steel pipe can be furnished in any size in one-inch increments, a problem could arise in securing the proper size for making a repair or an extension if other than standard sizes are specified. The Task Force, therefore, recommends that only standard sizes be specified.

8. The Task Force recommends that storm sewer pipe, of materials other than those currently in use by the City, be specified for test installations of 300-600 feet where research indicates that the material has merit. The test installations could be a selected part of a project where the effects on the overall project were negligible. It is not the intent of this recommendation to restrict the study of the new material to one installation, but to encourage installations under varying conditions, so that an accurate and complete evaluation can be made.

9. In order to help in the fight against corrosion, the ungalvanized welds and pipe ends should be factory painted and any areas where the galvanizing has been damaged in shipping or installation should be field-painted.

10. The Task Force recommends that gaskets be specified with hugger bands on all corrugated steel pipe joints to insure a proper and water-tight joint.

11. In order to make the service life of corrugated steel acceptable, the minimum allowable thickness should be established at 0.109 inches or 12 gauge.

12. The Task Force does not believe that the bituminous coatings and paving are accomplishing the purposes for which they have been specified; therefore, it is recommended that they no longer be permitted.

13. That a program of routine inspection of corrugated steel pipe storm sewers and test installations of other materials be initiated to provide a record on which to base future changes in sewer maintenance policy or construction material specifications. The inspections should be made by teams consisting of members from the Sewer Maintenance Division and the Engineering Department.

14. That the Task Force, after a reasonable period in which to implement the recommendations, be reconvened to determine, if, in fact, the recommendations have been implemented and are working as anticipated by the Task Force.

15. That the specifications for storm and sanitary sewers be rewritten to spell out in more detail that which the contractor is expected to do, and the results which he is expected to obtain and in the process, the specifications for storm and sanitary sewers be separated to eliminate the confusion which now exists in determining which parts are applicable to each kind of sewer. The Task Force further recommends,

that separate specifications be written for rigid and for flexible pipe.

16. That the Manning's Friction Factors (n) shown in the Appendix be adopted.

III HYDRAULIC EQUIVALENCE

Since velocities for storm water sewers are based on Manning's Formula ($V = \frac{1.49}{n} R^{2/3} S^{1/2}$), which is universally accepted by most governmental agencies, municipalities, and consultants, it is then apparent that the coefficient of roughness, or Manning's "n", will determine the capacity of any storm sewer with a given diameter, slope and flowing full.

Values of Manning's "n" were studied in numerous textbooks, handbooks produced by affected associations and from studies prepared by nearby municipalities. Values utilized by the Kansas Department of Transportation and those currently being used by the City of Wichita were also reviewed. It was determined that in the area of normal practicality, there was little variation in values used or proposed.

The values currently under use by the City of Wichita were found to be acceptable, but are, perhaps too refined for the usual degree of accuracy expected from normal hydrology and hydraulic equations. The Task Force did, however, question the coefficients assigned helical pipe and proposes modified values to reflect the Task Force's thinking.

Although the Task Force attempted to pursue a course which would permit alternate materials to be specified on the basis of only one design--which is the current practice--it soon became evident that this would not be possible. This is because, if the alternate materials have a wide difference in roughness coefficients, there will be a marked effect on velocities at the same slope. There can also be a problem with the physical installation of a larger pipe of equivalent

capacity because of lack of cover or interference with other utilities. Even though it is possible to prepare simple graphs showing pipe sizes for equivalent capacities, as have been included in the Appendix, the designer must check physical considerations and velocities to be sure that clearances are there for a larger pipe and minimum velocity is maintained. It will be necessary, in most cases, to make two designs if alternate pipe materials are to be specified.

The Task Force, after reviewing available literature and television tapes of existing sewer installations, is of the opinion that in order to avoid--as much as possible--the collection of silt and debris in the lines, a minimum cleansing velocity of 2fps at a depth of 0.2-full, should be adopted.

IV SERVICE LIFE

The first step to be taken during a discussion of Service Life, is to define the expression "Service Life." Based on the Task Force's study of numerous reports, letters, pictures and books, the following definition of Service Life was derived: "The length of time that a storm sewer system should function without major repairs or replacement."

The next step is to determine the minimum service life for which a storm sewer should be designed: A 1971 study by the Research Division of the Department of Planning and Development of the State of Kansas, concluded that a life of 40 to 50 years or more may be anticipated for normal galvanized steel pipe culverts in Kansas. This anticipated service life was applicable to most locations in Kansas except those near active coal mines. A majority of the pipes in this study were 16 gauge and 24 inches or less in diameter. A 1973 survey of 14 cities in the southeastern United States indicated that 71 percent of the surveyed cities accepted a 50-year use for a storm sewer. The Handbook of Steel Drainage and Highway Construction Products, estimates years to perforation of the invert of 16-gauge plain galvanized corrugated steel pipe in normal water (pH $\geq$ 5.8) to be 49 years. The Sewer Manual for Corrugated Steel Pipe, by the National Corrugated Steel Pipe Association, references a study conducted by the Los Angeles County Flood Control District, on CSP storm drains, which concluded that the crown zone of CSP could be assigned a service life of 100 years, provided an exterior coating was applied. The 1958 Edition of the Concrete Pipe Handbook, prepared by the American Concrete Pipe Association (ACPA), states that the universally accepted

life expectancy of a concrete pipe culvert is 100 years. Black and Veatch, Consulting Engineers, normally utilizes reinforced concrete pipe for storm sewers, and believes that its service life is almost indefinite. It is the opinion of the concrete pipe industry that concrete pipe has a useful service life of between 75 and 100 years. These sources are just a few of the opinions and statements that were found on this subject. Perhaps the service life of the structure, road or street which the storm sewer complements should govern. For example, the Federal Highway Administration requires a 50-year design life for interstate highways and this also applies to culverts.

The study prepared for the City of Wichita and Sedgwick County entitled "Pavement Design and Feasibility Study for Residential Streets Within the Wichita Metropolitan Area" defines the design life of pavement as the period of time in years for which the volume and type of traffic and the resultant wheel or axle loads are forecast, and on which, the structural design of the pavement is calculated and an acceptable driving surface provided without major maintenance. The study defines service life as the period of time the pavement will provide, with periodic maintenance, such as patching, and/or overlays, an acceptable riding surface for the traffic. The study points out that at the end of the design life the service life will be extended by an overlay which will last 20 years. It is apparent that as long as the base is sound, resurfacing by means of stripping and overlaying or by use of repaving machines such as the Cutler Repaver, the service life can be extended much beyond the design life.

If a service life expectancy could be assigned to each pipe, then it would be possible to compare these on a long term

economic basis, such as a cost-effective life-cycle, present-worth method. Another option that we have is to study the various methods of increasing the service life of corrugated steel pipe in order to make it an equal alternate storm sewer material. We also have the option to recommend that we maintain the status-quo or that corrugated steel pipe be removed from the plans and specifications. The Task Force, after careful deliberation, believes that the proper approach to this issue is to recommend ways of making corrugated steel pipe an equal alternate storm sewer material.

There are various methods of extending the service life, of corrugated steel pipe. These are: proper construction practices, soil corrosion protection, increase of metal thickness and the use of protective coatings and pavings.

The Task Force had the opportunity to view recent photographs of S.W.D. No. 25 in Harry Street, east of Airport Road, and the North Wichita Industrial Park storm sewer in 33rd Street North from St. Francis to Mead. These projects had some fully paved sections and it was apparent that some of the coating was beginning to fail. It could also be observed that piles of material, probably backfill, had infiltrated at some of the joints. The Task Force feels that most of this infiltration could have been eliminated with proper installation techniques and better construction inspection. Corrugated metal pipe is a flexible conduit that depends upon passive soil pressure for its design strength. This requires very meticulous backfill procedures to be specified and completed during construction. It was noted, that the pictures of the stacked pipe on the Ridge Road and Maple project, showed corrosion at the ungalvanized pipe ends. The possible solution to this problem could be field painting prior to installation.

Soil corrosion is best determined by its pH (hydrogen ion concentration) and its electrical resistivity (which indicates the relative quantity of soluble salts). For example, sea water has a resistivity of about 90 ohm centimeters, whereas ordinary tap water will usually be in the range of 10,000 ohm centimeters or higher. Soils and water with pH of 5.8 or more is considered normal, and pH of less than 5.8 is classified as acidic. Soils with an electrical resistivity of 0-2000 are considered to have a bad corrosion resistance, whereas anything above 4500 is considered good. In general, sand and granular backfills will have resistivity values of 8000 ohm/cm and higher. Perhaps an economical method to combat soil-side corrosion is by the use of sand and granular backfills. It is interesting to note that in the Kansas Study of Corrosion of Corrugated Metal Pipe, 1971, that 90 percent of the resistivities were between 700 and 2300 ohm/cm.

The most common types of protective coatings are zinc coatings (galvanizing), asphalt coating (plain and asbestos bonded), and polymeric or plastic coatings. Fully paved asphalt linings have been used in Wichita and the results have not been too encouraging. The most common problem appears to be the failure of the asphalt lining to adhere to the metal base.

There is a coating process which has been available for many years called "Asbestos Bonded Bituminous Coating." It has fibers of asbestos felt embedded in the galvanized coating of sheet steel which enable the bituminous coating or paving to adhere more tenaciously to the metal base. The American Iron and Steel Institute and the Utah State De-

partment of Highways report that the service life of asbestos bonded fully paved and coated corrugated metal pipe can be extended at least 25 years over the plain galvanized pipe. The Ohio Department of Transportation states that asbestos bonded bituminous coating and paving has performed very well and seems to have corrected the problem of adherence of bituminous protection. A report in 1976 by the Battelle Columbus Laboratories of Columbus, Ohio, stated that all of the asbestos bonded pipes with 35-36 years of service were reported to be in "very satisfactory condition", and the coating was reported to be "intact" or "like new." Asbestos bonding is a coating system which has been around a long time, is very dependable--according to the above sources--but apparently has never been used here.

Another way the Task Force believes corrugated steel pipe can be made a more equal storm sewer material, is to increase the base metal thickness. The American Iron and Steel Institute uses a corrosion-abrasion rate of 0.0013 inches per year for normal conditions ($pH \geq 5.8$). At that rate, it would take 84 years to perforate a wall thickness of .109 inches (12 gauge). The Task Force is of the opinion that increasing the thickness of the base metal is a more positive way to predict the service life of the corrugated steel pipe than is the use of asbestos bonded bituminous coatings.

During the study of service life, data became available on corrugated steel pipe with an aluminized coating rather than a galvanized coating, corrugated aluminum pipe and "Spriolite", a high-density polyethylene pipe. Presentations were made by representatives of the manufacturers of these three products and literature was obtained.

Aluminized corrugated steel pipe has been around for sometime, but none has been installed by the City of Wichita. Aluminized steel is a proprietary item of ARMCO, Incorporated, but it has recently been made available to other pipe makers. ARMCO makes some strong claims as to service life, as much as 75-100 years, but this is disputed by other steel manufacturers. The area of contention revolves around the ability of the aluminum to protect the base steel when the surface coat of aluminum has been scratched or otherwise broken. The claims are that the aluminum surface does not tend to "heal" itself as does the galvanized surface.

Corrugated aluminum pipe has also been around for sometime, but the City does not have any in place. Claims for service life are high, 75-100 years and more. Hydraulically, corrugated steel and aluminum are the same.

The material of which "Spirolite" is made, a high-density polyethylene material, has been used by the City for sanitary sewer applications with success to date, but this does not automatically mean that it would be as successful for a storm sewer application.

The Task Force is of the opinion that these products should be tested on a limited basis. This could perhaps best be done by specifying these materials for use on selected incidental drainage projects.

V INSTALLATION SPECIFICATIONS

Obviously those who were involved in the decision to permit the use of corrugated steel pipe as an alternate material for use in the construction of storm sewers, envisioned construction of corrugated steel pipe storm sewer systems with comparable quality of construction, hydraulic efficiency and service life to that which was known to be attainable with concrete pipe. Representatives of the corrugated steel pipe industry provided much information to those involved with making this decision. They gave testament to a high quality type construction of storm sewer systems utilizing corrugated steel pipe. However, photographs recently reviewed by this Task Force indicate that the quality type of corrugated steel pipe storm sewer systems envisioned by those responsible for making the decision to permit use of this material as an alternative to concrete pipe is <u>not</u> being attained. Recent photographs also viewed by this Task Force seems to indicate many like problems with concrete pipe storm sewers. The old cliche "the proof of the pudding is in the eating thereof", appears to be applicable in this situation. The "pudding" has now been tasted and the flavor appears to be less than the quality desired. The question now which appears before this Task Force is whether or not the "recipe" can be upgraded to produce the quality of "flavor" desired in the "pudding". This document will address installation specifications as one aspect of the "receipe" for quality storm sewer construction.

An understanding of the environment within which the specification writer must function is necessary prior to passing judgement on the adequacy of written specifications. Some

of the constraints, facts and assumptions which must be considered by the specification writer are as follows:

1. The specification writer assumes that the work to be completed for which the specifications are prepared will be constructed by a qualified competent contractor with thorough knowledge and expertise for that type of construction contemplated.

2. The specification writer assumes that the work to be completed for which the specifications are prepared will be inspected by qualified competent inspectors with thorough knowledge and expertise for that type of construction contemplated.

3. Problems have long been acknowledged in verbal and written communications from one person to another. The message sent is frequently misconstrued by the person receiving it. Many people are familiar with the parlor game where a simple message contained in a single sentence is to be passed from one person to another through a group of people. The final message received by the last participant is often times quite different from the message initially sent.

   This parlor game bears out the fact that the more complex the initial message, the greater the likelihood that the message received by the last participant will be severely garbled.

4. It is accepted practice that standard specifications do not describe in intricate detail every exacting movement and procedure required to physically complete the work.

Legal precedance exists whereby the courts have determined that specifications cannot legally bind a contractor to one special mode of operation when other modes of operation may possibly be used with the same end result. The specifications must, however, spell out in sufficient detail the results expected, and if the results expected are not obtained, then the specifications should provide a means for correcting the problem. All specifications are written with the intent that when the specifications omit a detailed description of an operation or procedure, the best accepted general practice shall be followed.

5. Standard specifications are not written to cover all cases in all circumstances. Frequently special provisions must be incorporated into the project contract documents covering unusual conditions which are not covered by the standard specifications.

6. Occassionally specifications describe a material product by using the name of a proprietary product or the name of a particular manufacturer to establish the type, function and quality desired with the addition of the phrase "or approved equal."

7. The American Society of Civil Engineers (ASCE) Manual of Practice No. 37, states "The ingenuities of the owner, engineer and contractor must be applied continually if construction costs are to be minimized and a quality job is to result. It is important to note, however, that the engineer's representative on the site is not expected to duplicate the detailed inspection of material and workmanship properly delegated to the manufacturer, supplier, and contractor". Toward this

objective, this Task Force encourages the City of Wichita in its efforts to provide American Public Association (APWA) training seminars for its construction inspectors. Contractor's field superintendents should also be encouraged to participate in this type of training. Manufacturers and Engineers also should exercise their responsibility for sharing their knowledge and expertise with the personnel involved in actual construction.

During discussions of this portion of the study it became evident that the majority of the Task Force desired more stringent specifications than now used by the City. Particular areas of concern were:

1. Final examination of the system prior to acceptance from the contractor. Final inspection procedures should be adopted such that the interior of all storm sewer pipes are visually inspected prior to acceptance of the project. The contractor should then be required to repair or replace any damaged pipe noted in the visual inspection prior to final acceptance of the project as required by the specifications.

2. Bedding and backfill of sewers. The importance of the proper bedding and backfilling of sewers cannot be over emphasized. The City has updated its standard specifications such that all storm sewer pipe will be installed on an improved bedding.

3. Protection against corrosion of steel pipe by means of sand or gravel encasement. The change in bedding and backfill specifications recently made by the City, does not go far enough to provide the encasement around the

corrugated steel storm sewer the Task Force feels is necessary to afford protection in corrosive soils. The designer should note, however, that as the City standard bedding requirements are now written, a load factor of 1.5 is provided. Special site conditions dictate variations in construction methods. The designer is responsible for specifing a higher class bedding or specifying a stronger conduit in situations where the standard specifications are not adequate to cover a special condition on a project.

4. A deflection limit on flexible pipe. Flexible conduits depend on deflection of the pipe to transfer loads on the pipe to the passive soil resistance of the backfill. Technical literature indicates that long term deflection may exceed initial deflection by as much as 24 to 50 percent. This continued deflection will lead to pipe failure and can, in most cases, be attributable to excessive deflection existing when the project was completed. With this in mind, it would seem appropriate to establish a limit for initial deflection. Technical literature concerning flexible conduits seem to uniformly recommend an initial deflection limit of five percent.

5. Compaction method for flexible pipe. The use of jetting or flushing for compaction in the installation of flexible pipe seems in the least to be a risky procedure, because it is most difficult to obtain equal compaction around the pipe. Where proper compaction is so vital to the structural integrity of the flexible pipe installation, it should be done with suitable material in layers, using hand and mechanical tampers.

VI MAINTENANCE

For the years prior to 1972, all City of Wichita storm water sewers were constructed of rigid manufactured pipe made of vitrified clay or Portland Cement concrete or by field assembly of vitrified clay blocks or brick to form rigid arches. There is no record that trunk storm water sewers were periodically inspected to evaluate hydraulic efficiency or condition; to inventory needed repairs or to take measures to preserve or extend service life of the sewer. Even as the Sewer Maintenance Division began to implement its preventive maintenance program for sanitary sewers in the late 1950s and early 1960s, the work program for storm water sewers consisted almost entirely of tasks aimed at reducing the time water was impounded on streets or private property. These tasks were "letting water down" (removing obstructions at inlet openings), unblocking small diameter collector pipes (usually at catch basin outlets), cleaning catch basins, repair of curbs and/or catch basin castings at inlets, replacing catch basin lids and miscellaneous repair to pipes damaged by various types of construction work.

Although there probably were instances where the condition of the trunk storm water sewer contributed to a significant loss of design capacity, there was no post-construction monitoring program to measure flow rates during storms and compare them with design flow rates. Where chronic ponding problems persisted past "letting down", catch basin cleaning, or lead pipe opening, they were generally attributed to "over-taxed" trunk lines. Only rarely did the problem turn out to be a failure of the pipe or arch materials.

In spite of the apparent shortcomings of this policy of benign neglect, it worked--not so much because of the policy, but because of the materials. As a practical matter, once in place the storm water sewers of ceramic or reinforced concrete were not subject to loss of hydraulic efficiency, change in cross section, or deterioration of surface. Recent inspections show no significant difference between concrete pipe storm sewers installed as long as 50 years ago and those installed recently.

City records show that one of the first concrete pipe storm water sewers in Wichita was laid in an alley (still unpaved) west of Laura between Harry and Osie, and in Laura from Osie to Funston. Installed in 1930, this line is still in service and was recently inspected with a television camera. Although the City began to log its cleaning activities in 1965, there is no record that this line has ever been cleaned. The TV inspection showed the presence of "hairline" cracks. These cracks were determined not be an indication of structural failure and showed no adverse effect on the operation of the sewer. The general condition of this line is good.

Beginning in 1972 or 1973, corrugated steel pipe was installed in City of Wichita storm water sewers and at least 40 projects totaling 60,247 linear feet of pipe of various sizes have been booked on City records to date. Records of the Sewer Maintenance Division of the Water Department show that no changes have been made in storm water sewer maintenance policy and that steel pipe has been neglected as benignly as concrete pipe has in the past. Inspections made recently, and 30 years of experience with coated steel culverts on the Wichita-Valley Center Flood Control Project, indicates that, at least with respect to the bituminous coatings and pavings, neglect will not work.

Because the Sewer Maintenance Division has less than ten years experience with steel pipe storm water sewers, because the Department of Engineering has no post-construction inspection and evaluation program for steel pipe storm water sewers, and because all, or almost all, literature and reports on use of steel pipe are for culvert installations; the experience with the coated and paved drainage culverts under levees on the Flood Control Project is considered to be the best indication of maintenance requirements for paved steel pipe storm water sewers. All of the steel drainage structures on the Flood Control Project were coated and paved, all were equipped with automatic floodgates on the outfall headwall and they vary in length from 30 to 50 feet. There were 72 culverts on the original Flood Control Project (not including Wichita Drainage Canal) ranging in size from 24-72 inches in diameter.

During one of the early periodic inspections of the Flood Control Project by Corps of Engineer officials, the problem of loss of coating and paving on several culverts, which had been damaged by fire, was reported. Local personnel were instructed to sandblast or airjet clean the metal surfaces and recoat and repave the damaged interior culvert walls with a bituminous material similar to the original coating. Several years later the same procedure was recommended for culverts whose coating and paving were damaged or lost due to chemical reaction.

Although the practices described above appeared to be effective at the time, the new coatings and pavings have not endured and it is difficult to distinguish them from others which have not been recoated. Some of the Flood Control Project culverts have been in service since 1950 and all were installed before 1960. None have been replaced and none are currently scheduled for recoating or repaving.

Inspection of several of the fully paved steel pipe storm water sewers installed in Wichita as early as 1973, and as late as 1981, revealed problems with the paving similar to the problems of the coatings and pavings of the Flood Control culverts. Detached, loosened or badly checked pavings were found at the outlet of all sewers inspected and the pattern of checking or cracking, especially near the bottom, was not limited to the outlet, as was suggested during Task Force meetings. Inspections also found several steel storm water sewers with considerable deposits on the floor of the pipe which prevented appraisal of the condition of a portion of the paving.

On April 23, 1982, the Sewer Maintenance Division attempted to clean three to four inches of deposit from the bottom of 390 feet of 48 inch diameter fully paved storm water sewer prior to making a TV inspection of the line. Most manhole openings in the line are less than 20 inches in diameter making a 15 inch diameter drag bucket complete with side bails the largest equipment that would pass through the manhole openings. As a consequence, the 15 inch drag bucket was able to make only a small opening in the center of the deposit on the floor of the 48 inch pipe. The TV inspection of the line following dragging was not successful because the camera illumination was absorbed by the black pipe interior and it was not possible to obtain sufficient contrast to analyze the video image. Although the TV inspection was not able to detect any damage to the paving, at least one rib of the drag bucket was coated with bitumin following the dragging operation. Some method for the removal of these deposits must be developed if the full design capacity of these sewers is to be restored. Other problems, such as the infiltration of backfill at joints also present unique problems in repairing paved steel storm

sewers. The standard practice to close such joints on concrete pipe is to use a Portland Cement grout but there is no way to bond such grout to the bituminous paving. A list of equipment and techniques used by the Sewer Maintenance Division to open blockages and clean concrete pipe storm water sewers is included in the Appendix. There is concern that many of the listed methods may seriously damage the steel pipe paving and further aggravate the paving repair problem. None of the literature available to the Task Force addressed this concern, except to warn that equipment should be handled with caution to prevent damage to the pipe and its coatings, linings, or pavement.

Use of plain corrugated steel pipe (CSP), in Wichita storm water sewers also began about 1972. A somewhat erratic pattern exists as to the sizes and locations where it was used as an alternate to fully paved steel pipe. Records show that most (18) projects used plain steel pipe for 24 inch diameter and smaller sizes and coated steel pipe for larger diameters although there were six projects which used plain CSP in sizes up to 60 inch diameter. Some earlier plain CSP installations are characterized by open joints and/or bent pipe ends which could catch drag buckets or cable clevises and further bend the pipe ends or even tear sections of the metal.

Experience in maintaining plain CSP has also been limited to culverts, but the number, size and variety of installation has provided a much better base from which to predict the needs of a maintenance program. For instance, the possible damage from fire or common petroleum distillates is greatly diminished and repairs to open or offset joints can be made with the same materials which have been used for years on

ceramic and concrete storm water sewers. A difference in requirements may come from the apparent predisposition of CSP to accumulate a sizable deposit on the pipe floor, and the occurrence, at least at some locations where moisture is present, of rust beneath the deposit. The pipe opening and cleaning practices mentioned earlier, (augering, knifing, creeping, dragging, and high pressure water jetting) are compatible with plain CSP if good field joints are made. Only experience will answer the question of whether or not cleaning production rates on the creeping and high pressure water jetting will be significantly less than for ceramic or concrete pipe because of the reduced hydraulic efficiency (refer to letter from Ace Pipe Cleaning in Appendix).

Another hazard to the operation and maintenance of storm water sewers is utility space conflict and encroachment of lines which are installed by boring or jacking. Storm water sewers are especially vulnerable to encroachment because the trunk lines are of large diameter and present a considerable obstruction to normal utility corridors, while the lead pipes connecting inlets to mains are often difficult to identify from the surface. With more and more utility services being installed by either boring or jacking, these encroachments go unnoticed until the storm water becomes blocked or the backfill failure reaches the surface. In most instances the small diameter utility line punches a two to three-inch diameter hole in the rigid pipe sidewalls without doing structural damage to the pipe. After the encroaching utility has been withdrawn the perforations in the rigid pipe sidewall can be grouted, either by hand or with the internal pressure grouting system owned by the Sewer Maintenance Division. There is reason to believe that an encroachment may, over time, cause major deformation of the sidewall of CSP. Eventually, after loss of backfill

through the encroachment rupture, the pipe could collapse. In any event the jagged metal at the encroachment rupture could damage high pressure water hose, video signal cable, firehose, rubber sleeves on internal grouting equipment and pressure grouting hoses.

As part of the research done by the Task Force a 36 inch plain CSP storm water sewer in an area east of Broadway and north of 25th Street North was inspected by television. At one point during the inspection it was discovered that a six inch diameter steel pipe had been driven through the top of the storm water sewer and extended into the sewer a distance of 30-34 inches. This situation apparently happened during the backfilling of the trench. In addition to the steel pipe, there were several deflected areas in the top of the CSP which are assumed to also have occurred during backfilling. Repair of the CSP at the point of the encroachment by the 6-inch steel pipe was made by excavating to expose the sewer, cutting the punctured section of CSP from the sewer and covering it with sheet metal.

VII APPENDIX

A. Recommended Manning's Friction Factors

B. Equivalency

   1. Equivalent Capacity Graph (2-2/3"x 1-1/2")
   2. Equivalent Capacity Graph (3"x 1")

C. Storm Conduit Sizing Chart

D. Recommended Gauges for Corrugated Steel Pipe

E. Photographs and Description of Sewer Cleaning Equipment

F. Letter From Ace Pipe Cleaning, Incorporated

G. Minimum Velocity - 2fps @ 20 Percent Diameter

RECOMMENDED MANNINGS FRICTION FACTORS

Reinforced Concrete Pipe	
All Sizes	n = 0.013
Corrugated Metal Pipe	
2-2/3" x 1/2" helical and circumferential corrugations	n = 0.024
3" x 1" helical and circumferential corrugations	n = 0.027

PIPE SIZING FOR EQUIVALENT CAPACITY BASED ON MANNINGS EQUATION FOR CIRCULAR PIPES FLOWING FULL

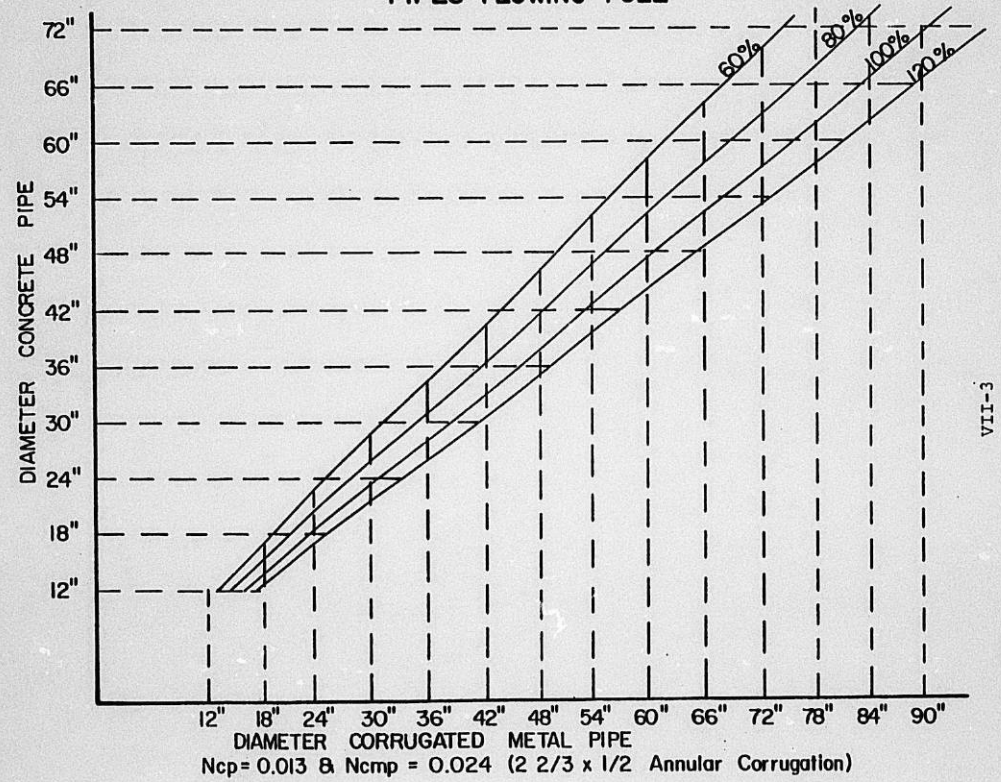


FIGURE 1

VII-3

PIPE SIZING FOR EQUIVALENT CAPACITY BASED ON MANNINGS EQUATION FOR CIRCULAR PIPES FLOWING FULL

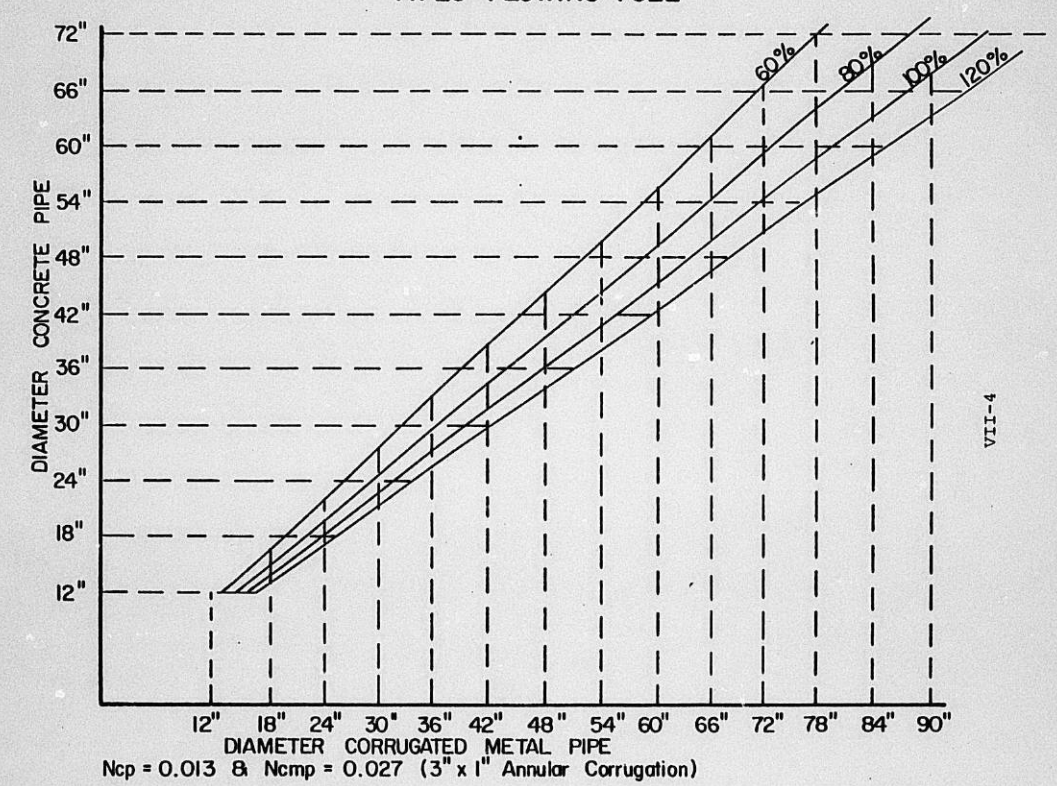


FIGURE 2

VII-4

C. Storm Conduit Sizing Chart

(See Attachment)

RECOMMENDED GAUGES FOR CORRUGATED STEEL PIPE

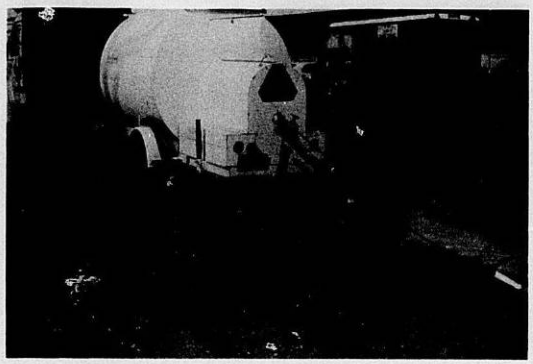
Circular Pipe Size in Inches	Arch Pipe Size in Inches	Gauge	Sheet Thickness in Inches
15 (2-2/3" x 1")	17 x 13	12	0.109
18 (2-2/3" x 1")	21 x 15	12	0.109
21 (2-2/3" x 1")	24 x 18	12	0.109
24 (2-2/3" x 1")	28 x 20	12	0.109
30 (2-2/3" x 1")	35 x 24	12	0.109
36 (2-2/3" x 1")	42 x 29	12	0.109
42 (2-2/3" x 1")	49 x 33	12	0.109
48 (2-2/3" x 1")	57 x 38	12	0.109
54 (2-2/3" x 1")	64 x 43	12	0.109
60 (3" x 1")	66 x 51	12	0.109
66 (3" x 1")	73 x 55	12	0.109
72 (3" x 1")	81 x 59	12	0.109
78 (3" x 1")	87 x 63	10	0.138
84 (3" x 1")	95 x 67	10	0.138
90 (3" x 1")	103 x 71	10	0.138
96 (3" x 1")	112 x 75	8	0.168

E. Storm Water Sewer Maintenance Tools & Equipment and Practices

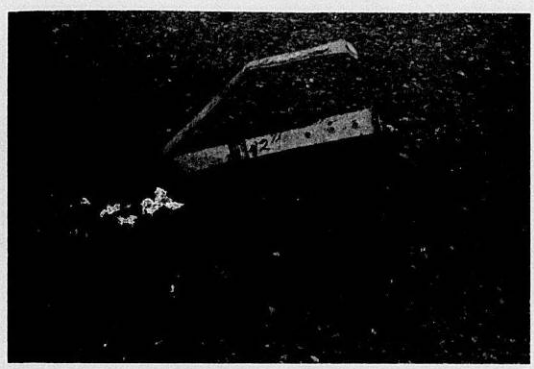
1. Portable, engine driven rod turning machine; steel sectional rods and augers (Photograph No. 1 below). These tools are used on short sections on small diameter sewers to open blockages caused by roots, limbs, boards, sticks and rocks. A crew of three is usually required for augering.

Photograph No. 1

2. Trailer mounted, engine driven, continuous steel rod rodding machine (Photograph No. 2) with spring-blade root knife (Photograph No. 3), used on small diameter (up to 18") sewers to cut roots. A crew of two is usually required for knifing.

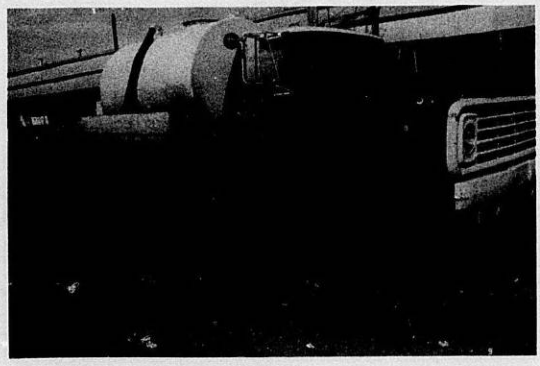


Photograph No. 2



Photograph No. 3

3. Truck mounted water supply tank and PTO driven medium pressure water pump with self propelling (creeper) nozzle (Photograph No. 4), used on culverts and short sections of sewer to flush out deposits. The nozzle propels itself and its water supply hose (usually fire hose), into the line and flushes out deposits as it is being manually retrieved. Where available, a fire hydrant can be used to supply water pressure and volume. Crew size depends on method of loading deposits and water supply.

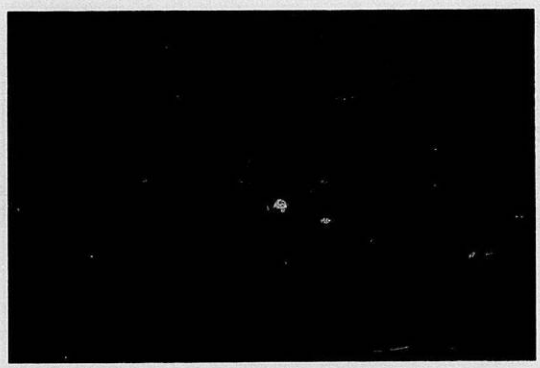


Photograph No. 4

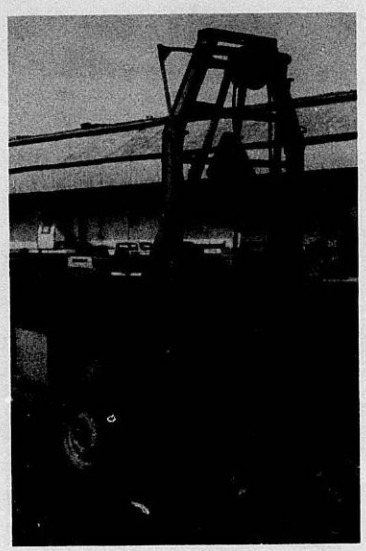
4. High pressure water jet cleaner mounted on vaccum loading truck equipped with water supply tank (Photograph No. 5). The jet cleaner is equipped with as much as 600 feet of small diameter, smooth coated hose which is jet propelled into the sewer; then hydraulically retrieved to flush deposits to the vacuum loading nozzle. The deposits are loaded into a large capacity hopper mounted on the truck chassis. A crew of two can operate the jet cleaning and vacuum loading operation but a water supply truck is often required

Photograph No. 5

5. Trailer mounted, engine driven winch and clamshell drag bucket (Photograph No. 7). One winch unit is set at each end of the sewer to be cleaned and the bucket is pulled into the sewer with the clamshell open, then retrieved with the clamshell closed; thereby carrying part of the deposit from the bottom of the sewer to the loading winch where it can be dumped. The clamshell drag (Photograph No. 6) is the only tool practical for cleaning sewers larger than 18 to 24 inches in diameter, and they are manufactured in sizes up to 36 inches; however, the largest bucket which can pass through a standard City of Wichita manhole casting is the 1[illegible] inch diameter. To use larger buckets, the manhole casting must be removed and part of the manhole stack torn down. The heavy steel clamshell drag buckets ride on skids. Each winch requires an operator and a dump truck is used to haul the deposits away.

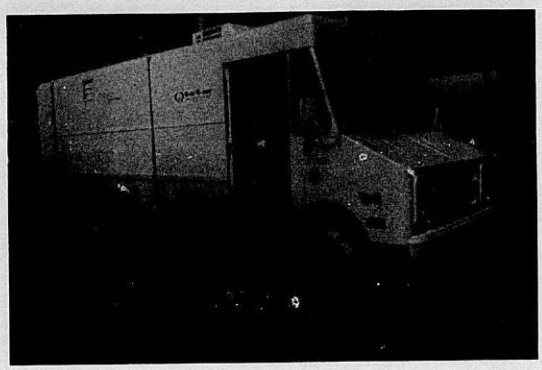


Photograph No. 6



Photograph No. 7

6. Mobile closed circuit television inspection and chemical grout repair unit (Photograph No. 8). The van contains the electrical power source to operate the closed circuit television inspection camera, monitor and videotape recorder and to operate the air compressor and multiplex chemical grout pump; chemical tanks; hose reels; winches and other tools.

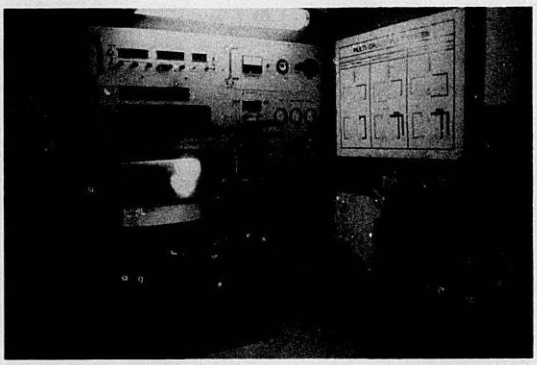


Photograph No. 8

7. Closed circuit television camera and light source mounted on skids for a 15 inch diameter pipe (Photograph No. 9). The camera is pulled through a sewer pipe by cable winch and sends a video signal to the monitor located inside the van control booth. TV inspection is the only method of determining the condition of small diameter (up to 36") pipe. Photographs of the TV image are used to improve the usability of written logs of TV inspections and when coupled with a videotape recorder can provide a permanent record.

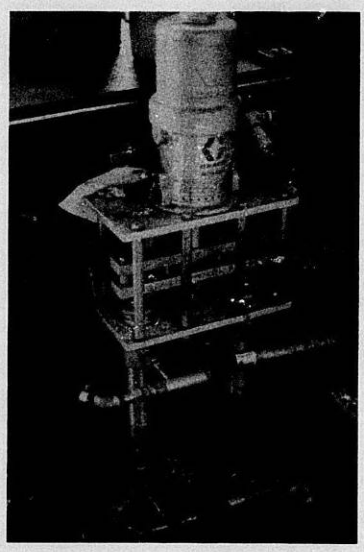
Photograph No. 9

8. TV inspection and chemical grout control booth (Photograph No. 10), which contains two-way communications speaker and headphones, TV monitor, videotape recorder, and controls for chemical grouting equipment.



Photograph No. 10

9. Chemical grout pump (Photograph No. 11), takes proper amounts of chemicals from each of two tanks and pushes the chemicals through separate hoses to the grout packer.



Photograph No. 11

10. Chemical grout crack and joint sealing packer in tandem with TV camera (Photograph No. 12). When a cracked pipe or open joint between pipes appears on the TV monitor, the operator can position the packer over the area to be repaired, inflate a sleeve at each end of the packer with compressed air and pump the two-part chemical grout into the cavity. Upon contact, the chemicals combine to form an acrylic plastic seal in the void. The sleeves are deflated, the packer moved away from the grout and the repair is inspected with the TV camera. Note that in the train connecting the packer-camera tandem are electrical power to camera and light source, compressed air to inflate the packer sleeves and two chemical compounds which must be kept separated until extruded from the packer. Normally a TV inspection-grouting crew consists of a control room operator, rear unit operator and far manhole winch operator.

Photograph No. 12

Ace Pipe Cleaning, Inc.
Specializing in today's needs for environmental protection.
4000 Truman Road • Kansas City, MO 64127 • (816) 241-2891

February 4, 1982

Mr. Irvin L. Penner
547 S. Christine
Wichita, Kansas 67218

Dear Mr. Penner:

In accordance with your request for cleaning various pipes and costs per foot we submit the following:

8 inch thru 21 inch concrete or clay tile sanitary sewers can be light cleaned by power rodding, power brushing or by flushing with the high pressure water jet machine and cost will be approximately $.50 to $.60 per foot.

8 inch thru 21 inch concrete or clay tile storm sewers or combination can be heavy cleaned with the high pressure water jet machine or bucket machine and cost will be approximately $.10 to $.15 per inch diameter.

24 inch thru 96 inch sanitary or storm sewers can be heavy cleaned with the bucket machine, scrappers or vactor units depending on the type of material in the sewers. These lines would have to be looked at before a price can be given.

Corrugated metal pipes are harder to clean and you have to be careful of what you use to clean them so as not to hang and tear holes in the pipe or the tar coating.

An example of cost on the 1,200 feet of 144 inch by 84 inch corrugated metal with 1 foot of material would be 450 cubic yards of material to be removed at approximately $150.00 per cubic yard.

All of the above prices would be with water and disposal site furnished.

If any questions, please feel free to call us.

Very truly yours,

ACE PIPE CLEANING, INC.

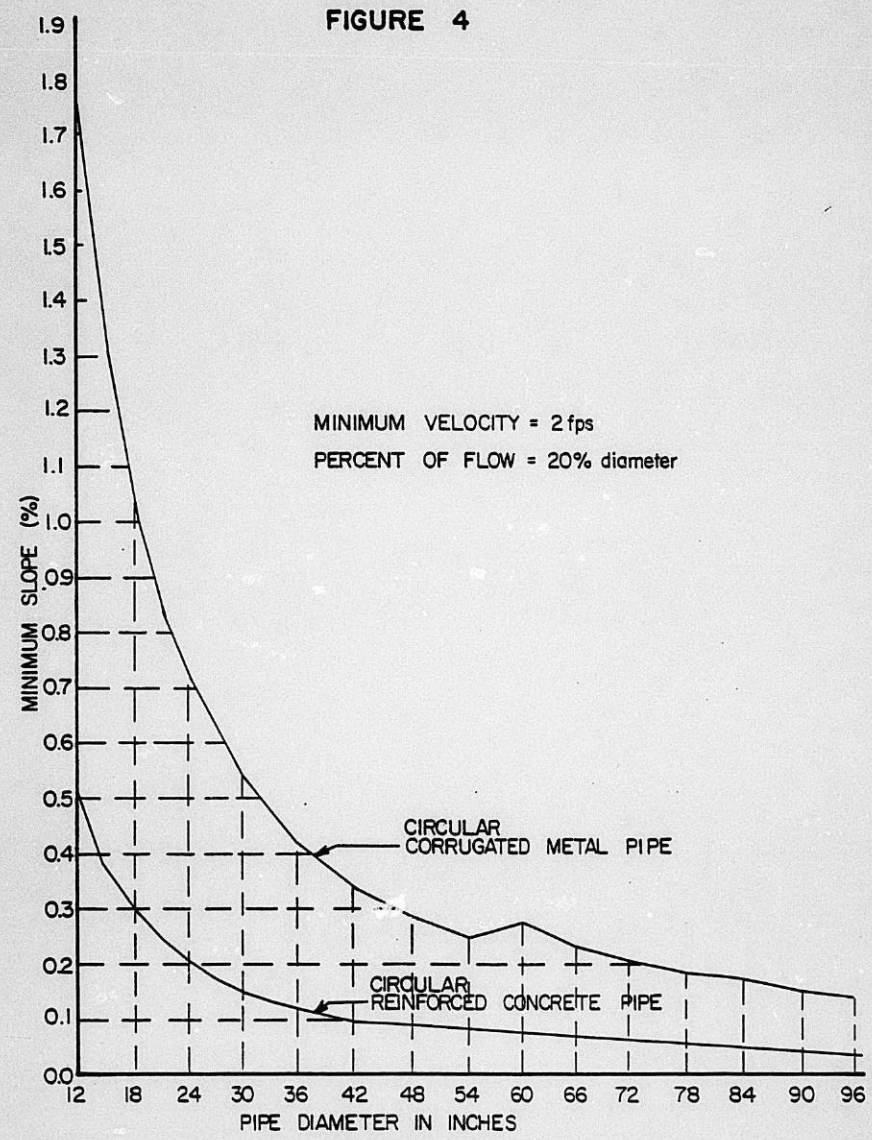
Harold D. Harper
President

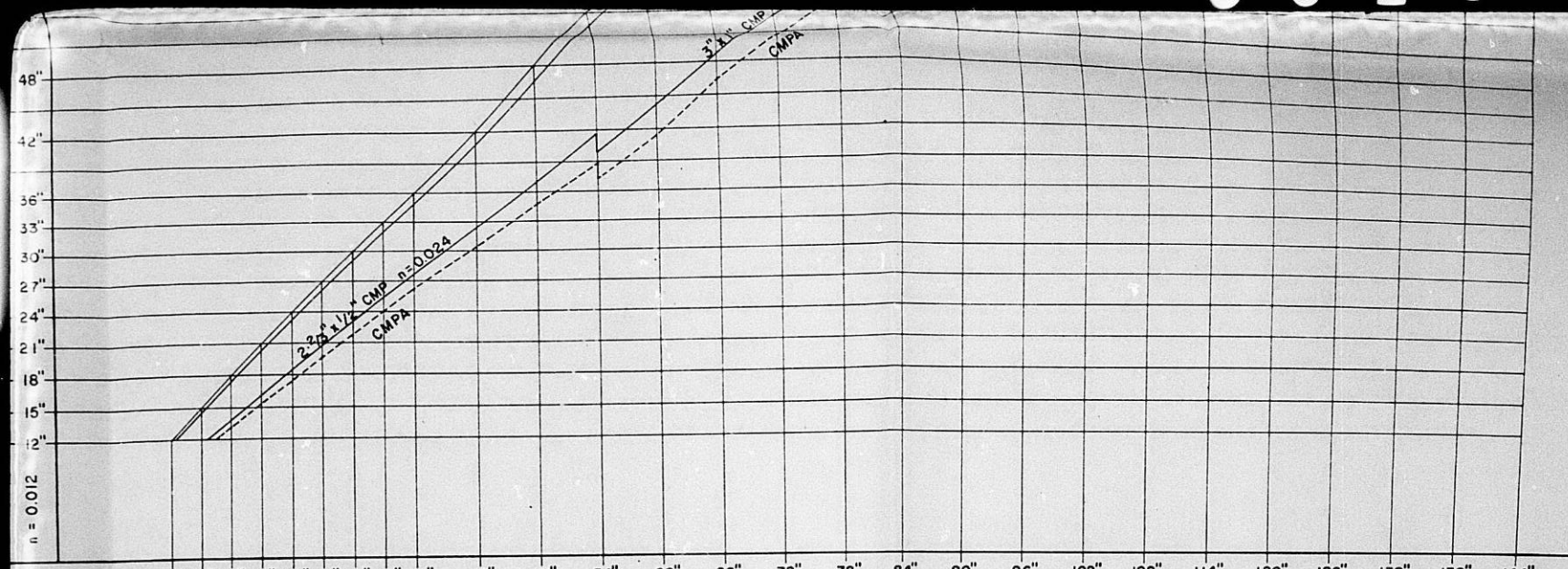
HDH:mg:lw

Enclosures

P.S. Also, enclosed you will find our literature on sewer cleaning and a brochure describing the various services we have to offer.

FIGURE 4


MINIMUM SLOPE (%)
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
MINIMUM VELOCITY = 2 fps
PERCENT OF FLOW = 20% diameter
CIRCULAR
CORRUGATED METAL PIPE
CIRCULAR
REINFORCED CONCRETE PIPE
12 18 24 30 36 42 48 54 60 66 72 78 84 90 96
PIPE DIAMETER IN INCHES



CIRCULAR	12"	15"	18"	21"	24"	27"	30"	33"	36"	42"	48"	54"	60"	66"	72"	78"	84"	90"	96"	102"	108"	114"	120"	126"	132"	138"	144"
ELLIPTICAL			23/14		30/19		38/24		45/29	53/34	60/36	68/43	76/48	83/53	91/58	98/63	106/68	113/72	121/77	128/82	136/87	143/92	151/97	158/102	166/106	174/110	180/116
ARCH (NOMINAL)			22/13		29/18		36/22		43/27	50/31	58/36	65/40	72/44	73/55	81/59	87/63	95/67	103/71	112/75	117/79	128/83	137/87	142/91	150/95	154/100	167/103	171/107

STORM CONDUIT SIZING CHART

MANNING FORMULA

$$Q = \frac{1.486 \cdot A \cdot R^{2/3} \cdot s^{1/2}}{n}$$

FLOWING FULL CONDITION where:

Q = FLOW (Cubic Feet per Second)
A = AREA (Square Feet)
R = HYDRAULIC RADIUS (Feet)
s = SLOPE (Feet per Feet)
n = FRICTION FACTOR (Manning)

DR 82-24

WILSON & COMPANY
ENGINEERS & ARCHITECTS

316 264-9175

Office Location... 218 NORTH WACO ▪ WICHITA, KANSAS 67202

Mailing Address... P.O. BOX 3119 ▪ WICHITA, KANSAS 67201

ENGINEERS
ARCHITECTS
PLANNERS

An Equal Opportunity Employer

23 May 1983

OFFICE COPY
DO NOT REMOVE

Mr. R. W. Bruggeman, P.E.
Director of Engineering
455 North Main, 7th Floor
Wichita, Kansas 67202

RE: City Standard Specifications
for Sanitary and Storm Sewers
WCEA File: 82-343

Dear Mr. Bruggeman:

Our first draft showing recommended changes is enclosed. We would suggest a meeting with you and your staff very early in your review so we can explain and discuss the changes. There are also several items we would like to discuss which are not directly reflected in the recommended specifications changes. One item is the format of the finished specifications. Others involve how we deal with recently developed pipe materials and other technical questions.

We will be glad to meet with you at your convenience.

WILSON & COMPANY

Ron Chandler

Ronald L. Chandler, P.E.
Manager

RLC:cac

Enclosure

CITY OF WICHITA
TECHNICAL SPECIFICATIONS
FOR STORM SEWER AND SANITARY SEWER
CONSTRUCTION

* * * * *

DRAFT FOR DISCUSSION

Prepared by Wilson & Company
23 May 1983

* * * * *

The base specification is the Revised City Standard Specification, Division IV. This draft shows recommended insertions in brackets, and recommended deletions crossed out.

DRAFT FOR DISCUSSION

DIVISION IV

Technical Specifications For Storm Sewer
And Sanitary Sewer Construction

INDEX

DIVISION IV

Technical Specifications For Storm Sewer
And Sanitary Sewer Construction

Section I. Materials

A. General. - All materials of whatever nature required in the construction of the work embraced in this contract shall be furnished by the Contractor subject to the inspection and approval of the City Engineer. All condemned material shall be immediately removed from the work to a yard provided by the Contractor and the Engineer will check all material and no material shall be taken from the yard without the consent of the Engineer. The Engineer shall at all times have full and complete authority to inspect all material and work and to condemn such as is not suitable for the proposed use and does not conform to the plans and specifications. The Contractor shall at all times provide ample facilities for the inspection of the work and testing of all material. Such inspection or non-inspection shall not release the Contractor from complying in every respect with the requirements of the plans and specifications up to the final completion and acceptance of the work.

B. Concrete. - Concrete and materials for concrete shall conform to the City of Wichita Standard Specifications for concrete pavement except as modified herein. All concrete shall be air-entrained. Cement used in concrete for sanitary sewer manholes shall be Type II. Cement used in all other concrete shall be Type I. The City Engineer may approve or may order the substitution of Type III cement for Type I, at any time, at no additional cost to the City.

Fine Aggregate For Concrete And Mortar. - Fine aggregate used in combination with coarse aggregate for brick manhole foundations, concrete encasement, pavement base repair, concrete pavement and concrete manholes shall conform to the City of Wichita Standard Specifications for concrete pavement.

Fine aggregate used for mortar shall conform to the same requirements as required for concrete pavement except that it shall have a gradation factor of not less than 2.75 and shall be free from dust, loam or dirt.

Coarse Aggregate For Concrete. - Coarse aggregate used in combination with fine aggregate for the construction of brick manhole foundations, concrete encasement, pavement base, concrete pavement and concrete manholes shall conform to the City of Wichita Standard Specifications for concrete pavement.

Cement. - Cement shall be Type I complying with the requirements of the latest revision of A.S.T.M. Designation C-150.

If the Contractor desires, he may substitute high early strength (Type III) cement at any location in which he so desires. Such substitution shall be made without extra expense to the City unless the City Engineer orders the substitution made in concrete used in street pavement. In this event, the Contractor will be allowed as an extra the difference in cost between standard Portland cement and high early strength (Type III) cement.

C. Reinforcing Steel. - Reinforcing steel shall conform to the same requirements as specified in the City of Wichita Standard Specifications for concrete pavement.

~~Concrete And Mortar Proportions. - Concrete used for brick manhole foundations, concrete encasement, concrete cradle, pavement base repair,~~

concrete pavement repair and concrete manholes shall conform to the City of Wichita Standard Specifications for concrete pavement.

Concrete used for repairing sidewalks, integral curb, combined curb and gutter and driveways shall conform with the requirements specified for these items as specified in the City of Wichita Standard Specifications for pavement construction.

[D. Mortar. -] Mortar used in constructing brick masonry structures for sanitary and storm sewers shall contain eight (8) sacks of Type I Portland cement per cubic yard, fine aggregate, and sufficient water to produce mortar of desired consistency. [Fine aggregate for mortar shall conform to the requirements specified for concrete pavement except that it shall have a gradation factor not less than 2.75 and shall be free from dust, loam or dirt.]

[E. Brick. - Brick shall meet the requirements for grade MS in A.S.T.M. C-32 or grade SW in A.S.T.M. C-62. Brick dimensions shall be suitable for wall thicknesses shown on the plans.

F. Manhole Castings. - Manhole castings shall be made of good quality gray iron, free from cracks, holes, swells and cold shuts. Manhole castings shall be manufactured to conform to the shape and dimensions and other requirements as shown on standard manhole detail. Manhole castings shall conform to Class 30 of A.S.T.M. Designation A-48. Manhole castings shall be coated with a hot asphaltum varnish coating applied at the foundry.

G. Pipe Bedding Material. - Type 1 Pipe Bedding Material shall be crushed rock conforming to A.S.T.M. C-33, Gradation No. 67 or to Kansas Highway Specifications for Type CA-4 coarse aggregate. Type 2 Pipe Bedding Material shall be a sand-gravel mix conforming to Kansas Highway Specifications for Type BD-2 under-drain aggregate. Type 2 Pipe Bedding Material may be used for the portion of the bedding below the bottom of the pipe only if the trenches are dry and stable and dewatering is not required. If the trenches are wet or unstable or dewatering is required, then Type 1 Pipe Bedding Material shall be used for the portion of the bedding below the bottom of the pipe and the depth of the bedding material shall be extended to a minimum depth of 12 inches below the bottom of the pipe. Type 3 Pipe Bedding Material may at the option of the Contractor be the same as Type 1 or Type 2; or it may be pit-run sand; or it may be select earth material which is free from large stones, clods or trash and contains proper moisture content for compaction. All Pipe Bedding Material shall be placed in lifts not greater than 6 inches and compacted to a density not less than 90% of maximum as determined by AASHTO Method T99.]

H. Clay Pipe For Sanitary Sewers. - All clay pipe shall be extra strength [vitrified] clay pipe conforming to the requirements of the latest revision of A.S.T.M. Designation C-700. Individual pieces shall not be less than five feet (5') in length except that shorter pieces may be used to facilitate connections at manholes. Where there is a change in horizontal or vertical alignment. Pipe will be rejected when the allowable variations as specified in the latest revision of A.S.T.M. Designation C-700 are exceeded and or when pipe fails to give a clear ringing sound when placed on one end and tapped with a light hammer.

Clay pipe shall be installed [on] [with] an improved bedding conforming with the standard drawing. ~~Granular material used for improved bedding shall be durable crushed rock conforming with the gradation requirements of the latest revision of A.S.T.M. Designation C-33 Size No. 67 (3/4" to No. 4). The improved bedding specified for clay pipe will not be paid for directly and this cost shall be included in the unit price bid for the pipe.~~

All pipe shall be subject to inspection at the factory, trench or at any other location previous to being placed in the ditch. Purpose of the inspection shall be to cull and reject pipe which, independent of the strength tests herein specified, fail to comply with the requirements of the specifications. All rejected pipe shall be plainly marked by the inspector and shall be replaced by the Contractor without additional cost. [Pipe will be rejected when the allowable variations as specified in the latest revision of A.S.T.M. Designation C-700 are exceeded or when pipe fails to give a clear ringing sound when placed on one end and tapped with a light hammer.]

The City of Wichita reserves the right to make strength tests at any time. Should the pipe tested fail to meet strength herein specified, additional tests will be made up to one percent (1%) of the total shipment. If one percent (1%) of the pipe delivered in one shipment fails to meet the tests, all the pipe will be rejected. If the pipe tested satisfactorily passes the strength requirements, Contractor will be expected to furnish free of cost not more than one pipe per thousand placed in the ditch. If the City elects to break more than one pipe in a thousand after the first pipe has passed its satisfactory strength test, the City will pay the Contractor at the invoiced price for the additional pipe broken.

Clay pipe may be either bell-and-spigot pipe or plain end pipe. Bell-and-spigot pipe shall have compression joints which conform to the requirements of the latest revision of A.S.T.M. Designation C-425, [Type I,] except

that the sealing element on both the bell and the spigot shall be affixed to the pipe in the factory. Plain end pipe shall have compression couplings which conform to the latest revision of A.S.T.M. Designation C-594 for Type B coupling except that the rigid external sleeve coupling for jointing the pipe shall be affixed to one end of the pipe in the factory. A lubricant shall be used as recommended by the manufacturer to facilitate the joining of the pipe.

I. Acroylonitrile-Butadiene-Styrene Composite Pipe For Sanitary Sewers. - Acroylonitrile-Butadiene-Styrene (A.B.S.) Composite Sewer Pipe shall conform with the latest revision of A.S.T.M. Designation D-2680. Only solvent cemented joints [using extra heavy solid wall extruded couplings of A.B.S. resin,] will be permitted. A.B.S. Composite Pipe shall be installed in accordance with the manufacturer's recommendations. [The pipe ends, whether manufactured or field cut, shall be coated with epoxy, coal-tar enamel or other suitable sealant approved by the pipe manufacturer.] ~~Contractors shall pay particular attention to the joining of sections of pipe such that the ends of the pipe butt each other without excessive gap. All joints having gaps of more than that which is acceptable between the ends of the pipe shall be repaired by the Contractor as approved by the Engineer at the Contractor's expense.~~ A.B.S. Composite Pipe shall be installed ☒ [with] an improved bedding [in accordance with the standard drawing.] ~~Improved bedding shall be placed on the trench bottom using durable crushed rock meeting the gradation requirements of the latest revision of A.S.T.M. Designation C-33 Size No. 67 (3/4" to No. 4).~~

~~The minimum depth of the granular material below the bottom of the pipe shall be either four inches (4") or one-fourth (1/4) of the pipe diameter when more than four inches (4"). The granular material shall be hand placed and compacted around the circumference of the pipe for the full width of the trench up to the centerline of the pipe.~~

~~The improved bedding for A.B.S. Composite Pipe will not be paid for directly, and this cost shall be included in the unit price bid for the pipe. Contractor must exercise special caution when flushing and/or vibrating backfill material to prevent pipe from floating.~~ Waterstop gaskets around the pipe shall be installed in all manhole walls. A.B.S. Composite Pipe may be Armco Truss Pipe or an approved equal.

J. Polyvinyl Chloride Pipe For Sanitary Sewers. - Polyvinyl Chloride (P.V.C.) Pipe having diameters of eight inches (8") or greater shall have clastomeric gasketed joints and shall conform to the latest revision of A.S.T.M. Designation D-3034 [for 15-inch and smaller pipe, and to A.S.T.M. Designation F-679 for 18-inch and larger pipe, and shall be rated] for S.D.R.-35. All P.V.C. pipe shall be installed in accordance with manufacturer's recommendations. P.V.C. pipe shall be installed ☒ [with] an improved bedding ~~with granular material hand placed and compacted to the top of the pipe~~ in accordance with the standard ~~detail~~ [drawing.] ~~Granular material used for improved bedding shall be durable crushed rock conforming with the gradation requirements of the latest revision of A.S.T.M. Designation C-33 Size No. 67 (3/4" to No. 4).~~

~~The improved bedding specified for P.V.C. pipe will not be paid for directly, and this cost shall be included in the unit price bid for the pipe.~~ Waterstop gaskets shall be installed around P.V.C. pipe in the manhole walls to prevent leakage.

All P.V.C. pipe shall be tested for deflection after it has been installed and [completely] backfilled. The pipe shall be tested by a mandrell, which is sized such that it will not pass through a pipe that has deflected

more than five percent (5%) of the pipe's internal diameter. The mandrell shall be pulled through each reach of P.V.C. pipe installed and any pipe which has deflected more than five percent (5%) shall be reconstructed by the Contractor at his expense. Any P.V.C. pipe reconstructed shall also be tested for deflection. The Contractor will be required to furnish all equipment and labor necessary to complete the deflection testing of P.V.C. pipe. ~~Deflection testing shall be accomplished only when the pipe has been completely backfilled and it shall be viewed by the Engineer or his representative.~~

K. Reinforced Concrete Pipe For Sanitary Sewers. - Reinforced concrete pipe for sanitary sewers shall be circumferentially reinforced concrete pipe with O-ring rubber gasketed steel joints. The pipe shall be reinforced with a cage or cages formed with circumferential and longitudinal steel. Steel joint rings shall be constructed at the ends of each length of pipe and securely fastened to the reinforcing steel and in the pipe. Each pipe shall be constructed with self-centering steel joints sealed with a rubber gasket and capable of withstanding normal movement due to displacement in the backfilled sewer trench. Pipe joints shall be sealed by a rubber gasket so that the joint will remain tight for normal conditions of service due to movement from expansion, contraction and backfill operations. The gaskets shall be fabricated from high-grade rubber compound, and shall conform to the requirements of the latest revision of A.S.T.M. Designation C-443.

Each pipe shall be provided with bell-and-spigot ends formed by steel joint rings securely fastened in the pipe and to the pipe reinforcement. The spigot ring shall be lined with concrete on its interior surface and the bell ring shall be covered with concrete on its exterior surface. Any portion of the steel joint ring which is exposed after the pipe is manufactured, shall be protected from corrosion by means of metallic zinc not less than 0.002 inch thick applied by the metalizing process. The spigot end of the steel joint shall be designed to receive, hold and protect the gasket. The joints shall be self centering so that the gasket will not support the weight of the pipe. Rubber and steel joints shall be installed in strict conformance with the pipe manufacturer's recommendations. Steel joint rings and gaskets shall be cleaned prior to joining and an approved lubricant shall be used to facilitate the joining. [The joint recesses between adjacent pipe shall be completely filled inside and outside with a plastic joint sealing compound. The joint sealing compound shall be a material compatible with the rubber gasket material, and shall be approved for such use by the manufacturer of the rubber gasket, and shall be further subject to approval by the Engineer.] ~~The inside bottom one-third of joint recesses between adjacent pipe shall be filled and pointed with mortar such that no mortar will extend inside the pipe beyond the inside circumference of the pipe. Joint recesses on the outside of the pipe shall be completely filled for the full circumference of the pipe using mortar and diapers.~~ The pipe supplier shall submit shop drawings to the Engineer for approval prior to manufacturing any pipe.

All reinforced concrete pipe for sanitary sewers shall be plastic lined over the upper 300 degrees (300°) segment of the pipe. The plastic lining may be Amer-Plate T-Lock Liner Plate, B.F. Goodrich Lok-Rib Koroseal, or an approved equal. The plastic lining manufacturer's recommendations for installing, sealing joints, testing and inspection of the plastic lining shall be considered as incorporated in and forming a part of these specifications. The pipe supplier shall furnish to the Engineer three (3) copies of plastic lining manufacturer's recommendations prior to the fabrication of any pipe.

All reinforced concrete pipe for sanitary sewers shall be Class III pipe unless specified otherwise by the plans. Circular reinforced concrete sanitary sewer pipe shall conform to the requirements of the latest revision of A.S.T.M. Designation C-76 for Wall B except as otherwise specified. Reinforced concrete arch sanitary sewer pipe shall conform to the latest revision of A.S.T.M. Designation C-506 except as otherwise specified. Reinforced concrete elliptical sanitary sewer pipe shall confrom with the latest revision of A.S.T.M. Designation C-507 except as otherwise specified.

Control tests shall be made during the manufacture of reinforced concrete sanitary sewer pipe to determine strength and absorption. Control tests shall be made by an independent testing laboratory at the expense of the Contractor.

[Reinforced concrete pipe shall be installed with an improved bedding in accordance with the standard drawing.]

L. Ductile Iron Pipe For Sanitary And Storm Sewers. - Ductile iron pipe shall conform to ANSI A21.51 or AWWA C151 and shall be thickness class 52 unless otherwise noted on the plans. Joints shall be either push-on joints or mechanical joints manufactured in accordance with Federal Specification WW-P-421c. When specified by the plans, ductile iron pipe shall be furnished with flexible joints capable of deflecting a minimum of 12½ degrees (12½?). Flexible joints shall be "Molox" as manufactured by American Cast Iron Pipe Company, "Usiflex" as manufactured by the United States Pipe & Foundry Company, or an approved equal. All exterior surfaces of ductile iron pipe shall be coated with a bituminous coating approximately one mil thick. The inside of ductile iron pipe to be used in constructing storm sewers having diameters of eight inches (8") or larger, shall have a one-sixteenth inch (1/16") thick cement lining with a bituminous coating in accordance with ANSI A21.4 or AWWA C104. The inside of ductile iron pipe to be used in constructing sanitary sewers having diameters of eight inches (8") or larger, shall be lined with a chemically inert liner such as "Polylined" as manufactured by United States Pipe & Foundry Company, "Polybond" as manufactured by American Cast Iron Pipe Company, or an approved equal. The chemically inert liner shall have a nominal thickness of 40 mils and a minimum thickness of 20 mils. Ductile iron pipe shall be used only when specified by Plans or Proposal. [Ductile iron pipe shall be installed with an improved bedding in accordance with the standard drawing.]

~~Cast Iron Pipe For Storm Sewers. - Cast iron pipe shall conform to ANSI A21.6, AWWA C106 or AWWA C108 and shall be thickness class 20 for 21/45 iron strength or thickness class 22 for 18/40 iron strength unless otherwise noted on the plans. Joints shall be either push-on joints or mechanical joints manufactured in accordance with Federal Specification WW-P-421c. When specified by the plans, cast iron pipe shall be furnished with flexible joints capable of deflecting a minimum of 12½ degrees (12½°). Flexible joints shall be "Molox" as manufactured by American Cast Iron Pipe Company, "Usiflex" as manufactured by the United States Pipe & Foundry Company, or an approved equal. All exterior~~

surfaces of cast iron pipe shall be coated with a bituminous coating approximately one mil thick. The inside of cast iron pipe to be used in constructing storm sewers having diameters of eight inches (8") or larger, shall have a one-sixteenth inch (1/16") thick cement lining with a bituminous coating in accordance with ANSI A21.4 or AWWA C104. Cast iron pipe shall not be used in constructing sanitary sewers. Cast iron pipe shall be used only when specified by plans or proposal.

M. Reinforced Concrete Pipe For Storm Sewers. - Reinforced concrete pipe for storm sewers having diameters of twenty-four inches (24") or less shall be Class III pipe unless specified otherwise by the plans. Reinforced concrete pipe for storm sewers having diameters greater than twenty-four inches (24") shall be Class III pipe when installed within street or alley right-of-way unless otherwise indicated by the plans. Reinforced concrete pipe for storm sewers having diameters greater than twenty-four inches (24") shall be Class II pipe when installed outside of street or alley right-of-way unless otherwise indicated by plans. Circular reinforced concrete storm sewer pipe shall conform to the requirements of the latest revision of A.S.T.M. Designation C-76 for Wall B. Reinforced concrete arch storm sewer pipe shall conform to the latest revision of A.S.T.M. Designation C-506. Reinforced concrete elliptical storm sewer pipe shall conform with the latest revision of A.S.T.M. Designation C-507. When rubber gasket type joints are specified, the joints shall conform with the latest revision of A.S.T.M. Designation C-443. [Otherwise, joints shall be tongue and groove joints sealed with flexible plastic gaskets conforming to the requirements of the latest revision of AASHTO M-198 for Type B gaskets. Gaskets shall be installed in strict accordance with the manufacturer's instructions and recommended installation procedures.] [Each length of pipe shall be furnished with tongue and groove ends. The inside bottom one-third of joint recesses between adjacent pipe shall be filled and pointed with mortar such that no mortar will extend inside the pipe beyond the inside circumference of the pipe. Joint recesses on the outside of the pipe shall be completely filled for the full circumference of the pipe with mortar. Mortar for filling joint recesses shall be mixed in volumetric proportions of one part cement to two and one-half parts sand and shall be sufficiently stiff to maintain its installed position.

Control tests shall be made during the manufacture of reinforced concrete storm sewer pipe to determine strength and absorption. Control tests shall be made by an independent testing laboratory at the expense of the Contractor.

[Reinforced concrete pipe shall be installed with an improved bedding in accordance with the standard drawing.]

N. Corrugated Metal Pipe For Storm Sewers. - Corrugated metal pipe [shall be galvanized steel and] shall conform to the applicable sections of Section 1905 of the 1980 Standard Specifications for State Road and Bridge Construction of the State Highway Commission of Kansas, and also conforming to relevant fabrication methods approved by AASHTO M-36, unless specified otherwise. All corrugated metal pipe furnished up to a circular diameter of fifty-four inches (54") or metal pipe arches smaller than 71" x 47" shall have corrugations with a pitch of two and two-thirds inches (2 2/3") and a depth of one-half inch (½") unless specified otherwise on the plans. All corrugated metal pipe specified larger than circular diameter of fifty-four inches (54") or metal pipe arch sizes larger than 64" x 43" shall have corrugations with a pitch of three inches (3") and a depth of one inch (1") unless specified otherwise on the plans. Corrugated metal

pipe used in the construction of storm sewers and culverts shall be furnished with the "Hugger" band coupler as manufactured by Armco Steel Corporation, or an approved equal, for connecting sections of corrugated metal pipe. The coupling bands shall be furnished and installed with gaskets ~~when specified by the plans~~ such that the connection will be water tight when completed.

Corrugated metal pipe shall be of the size and type as shown on plans. Corrugated metal pipe gage requirements shall conform with [the minimums] ~~that~~ as shown in the following table [unless otherwise shown on plans]:

Circular Pipe Size in Inches	Arch Pipe Size in Inches	Minimum Gage		Minimum Sheet Thickness in Inches	
12	-	~~16~~	[12	~~0.064~~	[0.109
15	17 x 13	~~16~~	12	~~0.064~~	0.109
18	21 x 15	~~16~~	12	~~0.064~~	0.109
21	24 x 18	~~16~~	12	~~0.064~~	0.109
24	28 x 20	~~16~~	12	~~0.064~~	0.109
30	35 x 24	~~14~~	12	~~0.079~~	0.109
36	42 x 29	~~14~~	12]	~~0.079~~	0.109]
42	49 x 33	12		0.109	
48	57 x 38	12		0.109	
54	64 x 43	12		0.109	
60 (3" x 1")	71 x 47	12		0.109	
66 (3" x 1")	73 x 55	12		0.109	
72 (3" x 1")	81 x 59	12		0.109	
78 (3" x 1")	87 x 63	10		0.138	
84 (3" x 1")	95 x 67	10		0.138	
90 (3" x 1")	103 x 71	10		0.138	
96 (3" x 1")	112 x 75	8		0.168	

Circular corrugated metal pipes larger than ninety-six inches (96") and corrugated metal pipe arches larger than 112" x 75" require special consideration, and the requirements for the larger pipes will be specified on the plans.

~~Corrugated metal pipe and pipe arches shall be coated both inside and outside before being fully paved inside (to meet the smooth flow requirement by the City) when required by the plans. Such coating shall be required for all metal pipe installations in corrosive soil areas and industrial areas where storm runoff has high potential of being chemically contaminated. The protective coating shall be either Hot-dip Bituminous or Polymeric to increase the durability and Design Life of the pipe. Bituminous coating shall conform to the applicable specifications of Section 1907 of the 1980 Standard Specifications for State Road and Bridge Construction of the State of Kansas. The polymeric coating shall be as specified by AASHTO Designation: M246-78, Type B (10 mils thick outside and 3 mils thick inside for corrosive soil areas, and 10 mils thick both surfaces in industrial areas). All connections for these fully coated metal pipes or both fully coated and fully paved pipes shall be constructed fairly water-tight, using Hugger type coupler or equal.~~

Corrugated metal pipe shall be handled with great care and caution to prevent damage to the pipe material, the zinc coating, bituminous or polymeric coating and the very delicate bituminous lining of the full ~~smooth flow pipe.~~] Any damage to pipe or coating [~~and/or lining~~] shall be repaired by the Contractor as approved by the Engineer. [Scrapes or scratches penetrating the galvanized coating shall be painted with organic zinc rich paint if approved by the Engineer.] Damaged pipe, which in the opinion of the Engineer cannot be satisfactorily repaired, shall be replaced by the Contractor.

[Corrugated metal pipe shall be installed with an improved bedding in accordance with the standard drawing.]

Corrugated metal pipe shall be subject to testing for deflection after it has been installed and backfilled, at the discretion of the Engineer. Deflection may be tested by a mandrell or by direct measurement of the vertical diameter or rise of the pipe. Pipe that has deflected more than 5 percent of its nominal vertical dimension shall be reconstructed by the Contractor at his expense. The reconstructed pipe shall also be tested for deflection. Testing of pipe with a diameter or vertical rise of 30 inches or less shall be by a mandrell and the Contractor shall be required to furnish all equipment and labor necessary to complete the testing. Testing of pipe with a diameter or vertical rise greater than 30 inches shall be by direct measurement by the Engineer's representative.

~~Corrugated metal pipe~~ shall be paid for at the unit ~~price bid for the~~ various sizes and ~~types as accepted and measured~~ complete in place. The unit price bid shall ~~include all costs of excavation~~, furnishing and ~~installing~~ pipe, furnishing and installing fittings, ~~compaction of all~~

back-fill material that is not to be flushed and vibrated, and any other incidentals necessary to complete the work. End sections shall be paid for at the price bid per lineal foot for the size of pipe on which the end section is to be installed as measured along the centerline of the end section.

For metal pipe sizes twenty-one inches (21") diameter and smaller, the corrugations shall run helically (spirally) around the pipe. For metal pipe sizes twenty-four inches (24") and larger, the corrugations may be circumferential (annular) and the inside of the pipe shall be fully paved.

Alternate Pipe Bedding Material. - A sand-gravel mix meeting the requirements of Type BD-2 aggregate for under-drain installations as specified in Section 1107 of the 1980 Kansas Standard Specifications for State Road and Bridge Construction may be used for granular bedding material instead of three-fourths inch (3/4") crushed rock when the sewer trenches are dry. Crushed rock meeting the requirements of A.S.T.M. Designation C-33 Size No. 67 shall be used whenever the trench bottoms are wet or when the trenches must be dewatered to facilitate installation of the sewer pipe. Sand-gravel bedding material shall be placed in lifts not greater than six inches (6") and compacted to a minimum density of ninety percent (90%) of optimum density.

O. Type Of Pipe Used. - Only one kind of pipe may be used on each storm sewer project, unless indicated otherwise by plans. [Allowable types of pipe and sizes for each type shall be as indicated by plans.] ~~Corrugated metal pipe is not to be inter-mixed with reinforced concrete pipe.~~ Only one kind of pipe is to be used between structures on storm sewer projects, unless approved otherwise by the Engineer.

Only one kind of pipe may be used on each sanitary sewer project, unless indicated otherwise by plans. When sanitary sewer plans do not indicate pipe types in size ranges from eight inches (8") to fifteen inches (15"), the Contractor shall have the option of using either P.V.C., A.B.S. Composite or vitrified clay pipe. Only one kind of pipe is to be used between manholes on sanitary sewer projects, unless approved otherwise by the Engineer.

See pg. 26.

P. Manhole Castings. - Manhole castings shall be made of good quality gray iron, free from cracks, holes, swells and cold shuts. Manhole castings shall be manufactured to conform to the shape and dimensions [and other requirements] as shown on standard manhole detail. Manhole castings shall conform to Class 30 of A.S.T.M. Designation A-48. Manhole castings shall be coated with a hot asphaltum varnish coating applied at the foundry. ~~Manhole frames and covers will not be paid for directly, and this cost is to be included in the price bid for manholes.~~

Section II. Construction Requirements.

A. Excavation. - All excavation shall be done by open cut from the surface except where necessary to tunnel under existing sewers or other underground utilities and in such other locations where tunneling is expressly permitted or directed by the Engineer. All trenches for sewers shall be excavated with a ladder type trenching machine. Excavation of

sewer trenches with a backhoe will not be permitted without prior approval of the Engineer. The Contractor shall strip and save the top six inches (6") of topsoil in unpaved areas when construction occurs on lots which have already been developed such that after the sewer is installed the topsoil can be replaced in its original location by the Contractor in a condition suitable for replanting grass. The trench width from the bottom of the trench to one foot (1') above the top of the pipe shall be a minimum of nine inches (9") and a maximum of twelve inches (12") wider on each side of the pipe than the outside diameter of the pipe unless otherwise authorized by the Engineer. The excavated soil shall be placed compactly along the side of the trench such as to be of the least inconvenience as possible to the traveling public and adjoining tenants. Trenches shall not be opened more than two hundred feet (200') in advance of the laying of pipe unless otherwise authorized by the Engineer. The Contractor will maintain the trenches such that they will be free of water and in no circumstances will pipe be laid in water. The control of ground water shall be such that softening of the bottom of excavations, or formation of "quick" conditions or "boils" during excavation shall be prevented. Well point dewatering systems shall remain in operation until trench has been backfilled. The Contractor shall not obstruct the gutter along pavement or any other water course. Any water courses disturbed or damaged by the Contractor shall be replaced by the Contractor at his expenses as approved by the Engineer.

Sewers will be constructed along the line and to elevations as shown by the plans. The Engineer will provide offset line and grade stakes as necessary to facilitate the construction. The Contractor will be required to furnish any other labor and material to properly locate the alignment and elevation of the trench excavation. ~~The City reserves the right to move the line of the sewer and to change the quantities given as approximate at the unit price bid.~~ The Contractor will be required to preserve all stakes and benchmarks and should he or any of his employees disturb or remove any stakes or benchmarks the cost of resetting them will be charged against any money due to the Contractor.

All trench excavation shall be unclassified and no direct [or additional] payment will be made when encountering rock, unusual soil conditions and/or water.

~~Trench excavation will not be paid for directly and the cost for this work will be included in the unit price bid for the pipe.~~ Surplus excavated trench material shall be disposed of by the Contractor as directed or approved by the Engineer. The cost of disposing of the excess excavated material, including loading and hauling for a distance not to exceed one half mile, shall be included in the unit price bid for the pipe. The Contractor also will be required to dump and spread the excess excavated material as directed by the Engineer at the destination hauled to without further compensation. When it is necessary to haul the surplus excavated material more than one half mile, the Contractor will be paid an allowance as set out in the contract for each cubic yard hauled more than one half mile when approved by the Engineer. Dewatering will not be paid for directly and when necessary, the cost shall also be included in the unit price bid for the pipe. Contractors should make subsurface soil evaluations as necessary when preparing their bids.

[B. Trench Stabilization. - The Engineer may direct that trench stabilization be installed when groundwater or unstable soil conditions are encountered. Trench stabilization shall consist of over-excavation and placement of additional compacted pipe bedding material in accordance with the standard drawing for trench stabilization. Any trench stabilization required as a result of surface water entering the trench, or to correct inadvertent overdepth trenching, shall be installed at the Contractor's expense.]

C. Installation Of Pipe. - Sewer pipe shall be installed true to line and grade. [All pipe bedding shall be improved bedding in accordance with the standard drawing for the type of pipe. Pipe shall be installed to bear uniformly along the length of the pipe barrel, with notches excavated where necessary to accommodate pipe bells.] ~~The bottom of the trench shall be shaped to fit the barrel of the pipe throughout not less than one-fourth of its circumference, except when improved bedding is specified due to the type of pipe or when the use of improved bedding is directed by the Engineer because of water or~~

unsuitable soil conditions. Notches shall be excavated where necessary to accommodate pipe bells. The Engineer may direct that the sewer pipe be installed on an improved bedding when unsuitable soil conditions or water is encountered. The approved bedding shall conform with the drawing included at the back of the specification book. Granular material used for improved bedding shall be durable crushed rock conforming with the gradation requirements of the latest revision of A.S.T.M. Designation C-33 size No. 67 (3/4" to No. 4). The Contractor shall have the option of using durable crushed rock conforming with the gradation requirements of the latest revision of A.S.T.M. Designation C-33 size No. 57 (1" to No. 4) for improved bedding to be used with reinforced concrete pipe or corrugated metal pipe. The Contractor at his option may substitute improved bedding in lieu of shaping the trench bottom to match the barrel of the pipe without any compensation for the improved bedding. The Contractor will be required to use improved bedding in any trenches that have been over excavated to a depth below that which is required without any compensation for the improved bedding.

Care shall be exercised in joining sewer pipes such that the pipe ends butt against each other without undue gaps. The sewer pipe shall be laid up grade beginning at the point of connection with the existing sewer or lowest flow elevation, unless otherwise approved by the Engineer. The sewer pipe shall be installed with the bell end forward or upstream, unless approved otherwise by the Engineer. When pipe laying is not in progress the forward end of the pipe shall be kept tightly closed with an approved temporary plug.

Maximum allowable gaps between the ends of the pipes at joints and maximum allowable offsets in the flowline between butting ends of pipe shall be as indicated in the following table for the various pipe sizes.

Pipe Size	Joint Cap	Flowline Offset
8"	1/2"	3/16"
10"	1/2"	3/16"
12"	9/16"	1/4"
15"	11/16"	1/4"
18"	11/16"	1/4"
21"	7/8"	3/8"
24"	7/8"	3/8"
27"	15/16"	1/2"
30"	15/16"	1/2"
36" or larger	1"	1/2"

Any sewer lines having flow elevations which deviate by more than one inch (1") from a straight line, as determined by the flow line of the two ends of pipe of any one line between structures, shall be reconstructed by the Contractor at his expense such that the flow elevations will not deviate by more than one inch (1") from the straight line previously described.

~~The cost of furnishing and installing sewer pipe shall be included in the unit price bid for the pipe. All costs in connection with the construction of improved bedding when its use is authorized by the Engineer due to unsuitable soil conditions shall be paid for at the~~

established price set out in the Proposal per ton of crushed rock placed for pipe bedding. No payment will be made for improved bedding used in lieu of shaping trench bottom, when required due to over depth excavation, due to unstable trench conditions as a result of wet weather, due to unstable trench condition which is a result of the Contractor's operations, or when its use is specifically required for the type of pipe being installed.

D. Backfilling. - All trenches and excavations shall be backfilled immediately after the joints are set. [Trench backfill to a depth 12 inches above the top of the pipe shall be improved bedding in accordance with the standard drawing for the type of pipe.] The trenches shall be backfilled with selected material free from stones or other hard material and compacted to ninety percent (90%) of standard density about the pipe to a depth of twelve inches (12") above the top of the pipe. Care must be taken during the tamping process so as not to injure or disturb the pipe.

All storm sewer trenches within alley or street right-of-way shall be backfilled with excavated material compacted to a density equal to or greater than ninety percent (90%) of standard density. Storm sewer trenches outside of alley or street right-of-way may be either backfilled with excavated material compacted to ninety percent (90%) of standard density or consolidated by flushing and vibrating. Sanitary sewer trenches having less than seven feet (7') of cover over the pipe in alley or street right-of-way shall be backfilled with excavated material compacted to a density of ninety percent (90%) of standard density. Sanitary sewer trenches having more than seven feet (7') of cover over the pipe in alley or street right-of-way may be either backfilled with excavated material compacted to a density of ninety percent (90%) of standard density or consolidated by flushing and vibrating. All sanitary sewer trenches outside of alley or street right-of-way may be either backfilled with excavated material compacted to a density of ninety percent (90%) of standard density or consolidated by flushing and vibrating. Trenches to be consolidated by flushing shall be sand backfilled when the excavated material is not suitable for backfill material as determined by the Engineer. The top two feet of trenches to be flushed within alley or street right-of-way shall be earth backfill compacted to a density equal to or greater than ninety-five percent (95%) of the standard density of the soil involved as determined by the Engineer. The top one foot of all other trenches to be flushed shall be earth backfill compacted to a density equal to or greater than the existing adjacent undisturbed material. Backfill material to be flushed shall be placed in six foot (6') maximum lifts when the trench is within alley or street right-of-way and in twelve foot (12') maximum lifts when the trench is outside of alley or street right-of-way. [Each lift shall be thoroughly consolidated by using water jets and vibrators. Water shall be applied so that effective settlement is obtained] with a minimum amount of water. Trenches shall not be permitted to overflow. Water shall be introduced into the bottom of the layer being flushed through a long pipe nozzle and in such a manner that disturbance of granular fill, tamped material or the previously placed layer will be held to an absolute minimum. The backfill shall be compacted to maximum density by using mechanical vibrating equipment after the backfill material has been

flushed with water. [Special care must be taken during the backfilling, flushing and compacting operations to pervent pipe from floating.] Backfill material shall be added as required in the top lift to compensate for settlement. Sand used for backfill material shall be relatively clean with one hundred percent (100%) passing the three-fourths inch (3/4") sieve, not more than twenty-five percent (25%) retained on a No. 4 sieve, and not more than ten percent (10%) passing a No. 200 sieve.

All costs in connection with trench backfill and compaction, including the disposal of surplus excavated material except as otherwise provided for by these specifications, will not be paid for separately and this cost shall be included in the unit price bid for the pipe.

E. Use Of Explosives. - When the use of explosives is necessary for the prosecution of the work, the Contractor shall exercise the utmost care not to endanger life or property, including new work. The Contractor shall be responsible for any and all damage resulting from the use of explosives.

All explosives shall be stored in a secure manner, in compliance with all laws and ordinances, and all such storage places shall be clearly marked. When no local laws or ordinances apply, storage shall be provided satisfactory to the Engineer and in general not closer than one thousand feet (1000') from the road or from any building or camping area or place of human occupancy. O.S.H.A. requirements shall be adhered to.

In advance of doing any blasting work involving the use of blasting caps within two hundred feet (200') of any railroad's tracks or structures, the Contractor shall notify the railroad of the location, date, time and approximate duration of such blasting operations.

Where electric blasting caps are being used close to a public highway, the Contractor shall erect warning signs in accordance with the latest edition of the Manual on Uniform Traffic Control Devices.

The signs shall be furnished and installed by the Contractor at his own expense.

The Contractor shall notify each public utility company, having structures in proximity to the site of the work, of his intention to use the explosives and such notice shall be given sufficiently in advance to enable the companies to take such steps as they may deem necessary to protect their property from injury.

Any Contractor desiring to use explosives within the city limits must first obtain a permit to do so from the City Fire Department.

F. Infiltration Testing And Television Inspection. - All sanitary [and storm] sewers larger than six-inch (6") constructed under this contract shall be inspected [visually or] with a television camera by the City of Wichita prior to acceptance by the City. All eight-inch (8") through twenty-four-inch (24") sanitary sewers constructed under this contract, shall be air tested by the City of Wichita prior to acceptance by the City. The Contractor will be required to conduct exfiltration tests on sanitary sewers larger than twenty-four-inch (24") prior to acceptance by the City. Any defects indicated by the [visual or] television inspection [,] air testing and/or exfiltration testing shall be corrected by the Contractor without additional compensation prior to acceptance of the project by the City. The lines shall be retested after repairs are made by the Contractor.

Air testing shall consist of measuring the amount of time required for the pressure to drop 1 psi from a starting pressure of approximately 4 psi in the length of sewer being tested between manholes. Permissible

elapsed time for a pressure drop of 1 psi shall be 4 minutes for eight-inch (8") pipe; 5 minutes for ten-inch (10") pipe; 5.5 minutes for twelve-inch (12") pipe; 7.5 minutes for fifteen-inch (15") pipe; 8.5 minutes for eighteen-inch (18") pipe; 10 minutes for twenty-one-inch (21") pipe; and 11.5 minutes for twenty-four-inch (24") pipe.

Exfiltration testing shall be conducted on sewers larger than twenty-four-inch (24") under the supervision of the Engineer. The Contractor shall conduct exfiltration testing on each reach of sanitary sewer pipe larger than twenty-four-inch (24") between manholes. Exfiltration tests shall be conducted by blocking off all manhole openings except those connecting within the reach being tested, filling the line with water and measuring the water required to maintain a constant level in the manholes. Each manhole shall be subjected to at least one exfiltration test. During the exfiltration test, the maximum water depth at the lower end shall not exceed twenty-five feet (25') and the minimum depth of water at the upper end shall be at least five feet (5') above the top of the pipe or the water elevation on the outside of the pipe, whichever is greater. The total exfiltration shall not exceed two hundred (200) gallons per inch of nominal diameter per mile of pipe per day for each reach tested. Manholes shall be considered as sections of pipe for purposes of determining the maximum allowable leakage. The exfiltration test shall be maintained on each reach of pipe for at least two hours and as much longer as necessary, in the opinion of the Engineer, to locate all leaks. The Contractor shall provide at his own expense all necessary piping between the reach of pipe to be tested and the source of water supply, together with equipment, labor and materials required for the test. The methods used and the time of conducting the exfiltration tests shall be subject to the approval of the Engineer. All leaks or other defects shall be repaired to the satisfaction of the Engineer. Any reach which exceeds the allowable maximum shall be re-tested after the leaks are repaired.

The cost of all additional testing and inspection in connection with repair work necessary to correct deficiencies in completed work on this project will be charged to the Contractor and may be deducted from the amount due on the final estimate.

C. Manhole Top Elevation. - The intent of this specification is to insure that tops of manholes will be constructed to match proposed finished grade in areas of new development and existing finished grade in areas which have already developed. The intent is to construct sanitary sewer manholes outside of paved or unpaved street, driveway and/or parking lot traveled ways to an elevation of 0.4' higher than the proposed finished grade or the existing finished grade. Tops of manholes constructed in proposed or existing paved traveled ways shall be set flush with the proposed or existing pavement. Tops of manholes constructed in proposed or existing unpaved traveled ways shall be constructed to an elevation of six inches (6") below the proposed or existing finished grade. Tops of storm sewer manholes constructed outside of paved or unpaved street, driveway and/or parking lot traveled ways shall be set flush with the proposed or existing finished grade.

Plans for sewer construction in new developing areas may indicate specific elevations for tops of manholes when the finished grade has been determined prior to completion of the plans. The Contractor and the Engineer must understand that tops of manhole elevations specified on any sewer plan were set according to the best information available at the time the plans were prepared and the actual top of manhole elevations should be based on the best information available at the time the manhole is actually constructed in conformance with the requirements in this specification as further approved by the Engineer.

When the plans do not indicate top of manhole elevations, the manhole top elevation shall be ascertained at the time of construction using the best information available in conformance with the requirements of this specification as further approved by the Engineer.

Additional manhole depth to facilitate actual construction of the tops of manholes to the required elevation, when different from that shown or indicated by plans and as approved by the Engineer, shall be considered as extra work and will be paid for accordingly [unless the added depth is less than one-foot, in which case no additional payment will be made.]

H. Manholes Type A And Type B. -[Manholes Type A and Type B shall be brick manholes constructed to conform with the requirements as shown by standard manhole detail.] Manholes shall be built according to the dimensions and having the thickness of wall as shown on the plans. Portland cement mortar shall be used in laying the brick. All brick shall be laid with shove joints. The outside of manholes shall be plastered with cement mortar, the same as is used in the joints, entirely covering the outside surface. [Price bid for manhole shown on the plans shall include furnishing and placing of all materials as shown on the plans, all labor, trimming and cleaning up the site at the manhole.

The floors of the manholes shall be shaped and smoothed so that flow channels will be formed such that the manhole will be self-cleaning and free of areas where solids may be deposited as sewage flows through the manhole from all inlet pipes to the outlet pipe. The floors shall have slopes of three inches (3") per foot on areas outside of the flow channels.

Manholes Type A and Type B shall be brick manholes constructed to conform with the requirements as shown by standard manhole detail. Brick used in the construction of brick manholes shall conform with the requirements as specified for grade MS in A.S.T.M. C 32-73 or grade SW in A.S.T.M. C 62-69. Brick shall have nominal dimensions which will permit construction of manhole walls to dimensions shown on standard manhole detail.] Brick manholes shall not be backfilled until the mortar has cured for twenty-four (24) hours.

I. Manholes Type C And Type D. - Manholes Type C shall be cast in place circular [concrete] manholes constructed to conform with requirements as shown by standard manhole detail.

Manholes Type D shall be cast in place, plastic lined, circular concrete manholes constructed to conform with requirements as shown by standard manhole detail. The plastic lining shall conform to the same requirements as specified for plastic lining in reinforced concrete pipe for sanitary sewers.

Forms used in the construction of cast in place circular concrete manholes shall be inspected and approved by the Engineer prior to use. The forms shall be made of metal and fabricated in sections which will permit easy installation and removal without damage to completed manhole. The forms shall be constructed such that the walls will have a thickness of eight inches (8") without any form marks on the interior or exterior exceeding one-fourth inch (1/4"). The upper portion of the form shall be constructed such that the finished manhole will taper from forty-eight inches (48") in diameter to twenty-six inches (26") in diameter in a minimum distance of thirty inches (30") and a maximum distance of forty-eight inches (48").

The concrete base may be placed integral with the walls or the base can be placed separately as approved by the Engineer. The floor of the manholes shall have a minimum thickness of nine inches (9") below the bottom of the lowest pipe and the diameter of the base shall be a minimum of eight inches (8") greater than the outside diameter of the manhole barrel. The floor of the manhole shall be shaped and smoothed so that flow channels will be formed such that the manhole will be self-cleaning and free of areas where solids may be deposited as sewage flows through the manhole from all inlet pipes to the outlet pipe. The floor shall have a slope of three inches (3") per foot outside of the flow channels.

Concrete used in the construction of cast in place manholes shall conform to the standard specifications of concrete for concrete pavement unless specified otherwise and shall contain a minimum of six (6) sacks of cement per cubic yard. The maximum permissible slump for concrete used in the construction of cast in place manholes is four inches (4"). The concrete shall be placed in the forms in two-foot (2') layers in such a manner that will prevent segregation. The concrete in the manhole base and each layer of concrete in the manhole walls shall be thoroughly rodded or vibrated to eliminate honeycombing. Forms shall not be removed from the walls of the manhole until the concrete has set up sufficiently to prevent damage to the walls by the form removal operation. The length of time between the placing of concrete and removal of forms will vary depending upon weather conditions. Placing concrete will not be permitted when the temperature is thirty-two degrees (32°) F. or below without the approval of the Engineer. Concrete placed during cold weather shall be protected from freezing for a period of seven (7) days after completion of the placement operations.

Backfilling will not be permitted until a period of twelve (12) hours has expired after the removal of the forms. The Contractor shall be required to provide an adequate method for curing the concrete during the period between the removal of forms and prior to completion of the backfilling operatiion.

Manhole locations which require pipe inlets through cast in place circular manhole walls will be constructed by cutting an opening in the manhole wall at the proper location after the forms have been removed. The pipe will then be installed in the opening using the correct alignment and grouted in place. The space between the pipe and the manhole wall shall

be completely filled with grout. All grouting shall be done with non-shrinking mortar using shrinkage-correcting aggregate such as Master Builder's "Embeco", Sonneborn "Ferrolith G-DS", or an approved equal. The grouted inlet pipe connection shall be sealed on the exterior with Bitumi-nastic Super Service Black as manufactured by Koppers, Tarmastic 103 as manufactured by United States Steel, 450 Heavy Tenemecol as manufactured by Tnemec or an approved equal. Application shall conform to manufacturer's requirements.

~~Manholes shall be paid for at the bid price for each manhole constructed as shown by plans or as ordered by the Engineer. The price bid for manholes shall be considered as full compensation for all materials, labor, excavating, backfilling and any other incidentals necessary to complete the work.~~

J. Reinforced Concrete Manholes. - ~~Concrete and reinforcing steel used in the construction of reinforced concrete manholes shall conform to the requirements of the City of Wichita Standard Specifications for concrete pavement. The floors of all reinforced concrete manholes shall be shaped to increase hydraulic efficiency using a mix containing fine aggregate and eight (8) sacks of cement per cubic yard. The floors of the manholes shall be shaped and smoothed so that flow channels will be formed such that the manhole will be self-cleaning and free of areas where solids may be deposited as sewage flows through the manhole from all inlet pipes to the outlet pipe. The floors shall have slopes of three inches (3") per foot on areas outside of the flow channels.~~ Reinforced concrete manholes constructed on sanitary sewers shall have all areas of concrete that would otherwise be exposed to sewer gases [, except the floors,] protected with plastic lining. The plastic lining for reinforced con-crete manholes shall conform to the same requirements as specified for plastic lining for reinforced concrete sanitary sewer pipe. Reinforced concrete manholes shall not be backfilled until a period of seventy-two (72) hours has expired after the removal of the forms.

~~Reinforced concrete manholes shall be paid for at the price bid for each reinforced concrete manhole constructed as shown by plans. The price bid shall be considered as full compensation for all materials, labor, excavating, backfilling and any other incidentals necessary to complete the work.~~

K. ~~Standard~~ Inlets. - Inlets are to be ~~standard~~ [brick or reinforced concrete] inlets as indicated by the plans. Construction requirements, brick, and mortar shall conform to the same requirements as specified for brick manholes. ~~Concrete and reinforcing steel shall conform to the same requirements as specified for these items in the City of Wichita Standard Specifications for Concrete Pavement.~~ Steel inlet covers shall conform to the dimensions shown by the standard detail sheet and to the requirements for "Structural Steel" A.S.T.M. Designation A-36. All exposed structural steel surfaces shall be painted with two coats of aluminum paint. Inlet cover castings and inlet ring castings shall conform to the same requirements as specified for manhole castings except for weight. ~~The price bid for each inlet constructed as shown on the plans or as ordered by the Engineer shall include all costs for completing this item including furnishing and placing all materials, all labor, excavation, backfilling, compaction of backfill and cleaning up the site at the inlet.~~ Brick

inlets shall not be backfilled until the mortar has cured for twenty-four (24) hours. Reinforced concrete inlets shall not be backfilled until a period of seventy-two (72) hours has expired after the removal of the forms.

~~Inlet details shall conform to the requirements shown on the standard detail sheet for the type specified.~~ Inlets with concrete tops shall have rings and covers according to the following schedule.

Inlet Length (Feet)	Number of Rings & Covers
5	1
6-10	2
11-15	3
16-20	4

The rings shall be spaced such that there is a maximum of two and five-tenths feet (2.5') from the inside of the wall to the center of the ring and a maximum of five feet (5') from center to center between rings. Rings and covers shall be centered between the front and the back of the concrete tops. The number and spacing of rings with covers may vary from this specification only when approved by the ~~Field~~ Engineer. At least one (1) manhole ring and cover shall be placed such that it is aligned with the centerline of the outfall pipe or pipes.

[L. Concrete Work. - Concrete mixing, handling, placing, jointing, finishing, curing, protection and testing shall conform to the City of Wichita Standard Specifications for concrete pavement except as modified herein.]

~~Cold Weather Concreting. - No concrete shall be mixed, placed or finished when the natural light is insufficient, unless an adequate and approved artificial lighting system is operated.~~

~~Unless authorized in writing by the Engineer, mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches forty degrees (40°) F. and not resumed until an ascending air temperature in the shade and away from artificial heat reaches thirty-five degrees (35°) F.~~

~~When concreting is authorized during cold weather, the aggregates may be heated by either steam or dry heat prior to being placed in the mixer. The apparatus used shall heat the mass uniformly and shall be so arranged to preclude the possible occurrence of overheated areas which might injure the materials. Aggregates shall not be heated directly by gas or oil flame or on sheet metal over fire. When aggregates are heated in bins, steam-coil or water-coil heating or other methods which will not be detrimental to the aggregates, may be used. The use of live steam on or through binned aggregates will not be permitted. Unless otherwise authorized, the temperature of the mixed concrete shall not be less than fifty degrees (50°) F. and not more than ninety degrees (90o) F. at the time of placing it in the forms. Under no circumstances shall concreting operations continue when the air-temperature is less than twenty degrees (20°) F.~~

~~If the air temperature is thirty-five degrees (35°) F. or less at the time of placing concrete, the Engineer may require the water and/or the aggregates to be heated to not less than seventy degrees (70°) F. nor more than one hundred fifty degrees (150°) F. No concrete shall be placed on frozen subgrade nor shall frozen aggregates be used in the concrete.~~

~~When concrete is being placed during the time that the air temperature may be expected to drop below forty degrees (40?) F., the Contractor will be required to protect the work by covering it with a suitable moisture barrier such as wet burlap or plastic sheeting and a suitable blanketing material such that will maintain a minimum temperature of forty degrees (40?) F. in the concrete as measured on the surface of the work. This type of curing shall be maintained for duration of ninety-six (96) hours after the concrete has been placed as long as the air temperature is expected to go below forty degrees (40?) F. anytime during the ninety-six-hour (96) period.~~

M. Measurement and Payment for Sewers. - Payment for work performed under this Contract will be made at the approved unit price or lump sum price for each of the several items as listed in the proposal and measured as hereinafter specified. Such payment shall be compensation for all costs in connection with furnishing all labor, equipment and materials required and performing the operations necessary to complete the project. All incidental and appurtenant work essential to the completion of the pay items shall be considered subsidiary and shall be accomplished without additional cost to the City.

The quantities of items listed in the proposal are not guaranteed quantities and are listed only for comparing bids. Payment will be made for the actual quantities constructed or installed, be they more or less than the listed quantities. The City reserves the right to move the line of the sewer and to change the lengths of the sewer within the general locations shown on the plans.

Sanitary Sewer, of the respective size shown, shall be measured from the ends of existing sewers to the centerline of the manhole, from centerline of manhole to centerline of manhole, and from centerline of manhole to the end of the new sanitary sewer pipe.

~~Measurement And Payment For Sewers. - Sanitary sewer pay length shall be measured from the ends of existing sewers to the centerline of the manhole, from centerline of manhole to centerline of manhole, and from centerline of manhole to the end of the new sanitary sewer pipe. Four-inch (4") and six-inch (6") stubs shall be installed in manholes when shown by the plans or when directed by the Engineer to facilitate connection of building service lines. All four-inch (4") and six-inch (6") stubs shall be extra strength clay pipe conforming with the latest revision of A.S.T.M. Designation C-700. Four-inch (4") and six-inch (6") P.V.C. or A.B.S. Pipe shall be S.D.R. 23.5 pipe. Four-inch (4") stubs shall be paid for at the price bid for each four-inch (4") stub installed as approved by the Engineer. Six-inch (6") stubs shall be paid for at the price bid for each six-inch (6") stub installed as approved by the Engineer.~~

Storm sewer [, of respective size and type shown,] ~~pay length~~ shall be measured from the ends of existing sewers to the centerline of manhole, combined inlet-manhole or inlet; from centerline of manhole, combined inlet-manhole, or inlet to centerline of manhole, combined inlet-manhole or inlet; and from centerline of manhole, combined inlet-manhole, or inlet to the end of the new storm sewer pipe. End sections will not be paid for separately but will be measured and paid for as lineal feet of pipe as measured along the centerline [flowline] of the end section.

[Payment for sanitary sewer and storm sewer shall be per lineal foot of sewer actually constructed and shall include all costs in connection with furnishing and placing pipe and all subsidiary items including pipe fittings and joints, trenching and backfilling, compaction of backfill, improved pipe bedding and compaction of bedding materials, water for compaction, dewatering, rock excavation, testing, protection or relocation of obstructions, temporary services if required, site cleanup and disposal of surplus and waste materials, and all other incidental and appurtenant work to complete the item.

Payment for manholes and inlets, of the respective type shown, shall be for each such manhole and inlet actually constructed and shall include all costs in connection with furnishing and placing concrete, brick and mortar, reinforcing steel, castings and structural steel, ring and cover, riser pipe and fittings, and all subsidiary items including structure excavation and backfilling, compaction of backfill, water for compaction, pipe connections, dewatering, rock excavation, testing, site cleanup and disposal of surplus and waste materials, and all other incidentals and appurtenant work to complete the item.

Payment for trench stabilization shall be per cubic yard of trench stabilization actually constructed at the direction of the Engineer and approved for separate payment by the Engineer; the quantity to be calculated as the length of approved stabilization for a trench width equal to the specified maximum allowable for the size and type of pipe, and for a depth of 12 inches or a greater depth if directed by the Engineer; such payment shall include all costs in connection with additional trenching depth, furnishing, placing and compacting additional pipe bedding material, and all other incidental and appurtenant work to complete the item.]

Section III. Incidental Construction.

A. Manholes Removed. - Manholes designated for removal shall be completely removed. All abandoned pipes which remain after the manhole has been removed shall be plugged. The excavation shall be backfilled in accordance with the requirements as specified for sewer trench backfill. The castings shall be salvaged, cleaned and delivered to the City Maintenance Yard. The unit price stated in the Proposal shall cover all costs for completion of this item including removing the manhole, salvaging manhole castings, backfill, compaction of backfill, delivering manhole castings to the City Maintenance Yard and disposal of the debris. Pipe plugs will be paid for separately.

B. Inlets Removed. - Inlets designated for removal shall be completely removed. All abandoned pipes which remain after the inlet has been removed shall be plugged. The excavation shall be backfilled in accordance with the requirements as specified for storm sewer trench backfill.

All castings and covers shall be salvaged, cleaned and delivered to the City Maintenance Yard. The unit price stated in the Proposal shall cover all costs for completion [~~if~~] [of] this item including removing the inlet, salvaging castings and covers, backfill, compaction of backfill, delivering salvaged castings and covers to the City Maintenance Yard, and disposal of the debris. Pipe plugs will be paid [for] separately.

C. Observation Holes Removed. - Observation holes designated to be removed shall be completely removed for the full depth to the top of the tee fitting in the sanitary sewer, unless otherwise indicated by the plans. The opening left by removing the observation hole shall be plugged with concrete as approved by the Engineer. The top half of the sewer pipe shall be encased with a minimum thickness of six inches (6") of unreinforced concrete encasement for a minimum distance of eighteen inches (18") in both directions from the centerline of the original observation hole

D. Manholes Adjusted. - Manholes designated for adjustment shall be raised or lowered as necessary such that the casting will conform to the required elevation. Construction and material requirements shall conform to the same requirements as specified for new manhole construction. An approved type of flat concrete slab shall be used to support the manhole ring where it is necessary to lower manholes or brick stacks having corbels more than twelve inches (12"). Flat concrete slab manhole tops shall conform to the requirements of A.S.T.M. C-478 in addition to the following requirements. All surfaces of the flat concrete slabs installed on sanitary sewer manholes which would be exposed to sewer gas shall be protected by a plastic lining. This plastic lining shall conform to the same requirements as specified for plastic lining for reinforced concrete sanitary sewer pipe. A minimum six inch (6") brick collar conforming to the same type of construction as specified for brick manholes shall be installed between the manhole ring and the flat concrete slab to facilitate minor adjustments for elevation unless approved otherwise by the Engineer. All contact surfaces between brick masonry, flat concrete slab and cast iron ring shall be sealed with a layer of mortar. Manholes having corbels which must be raised more than twelve inches (12") will require removing the draw section completely to facilitate reconstruction of a standard draw section. When it is necessary to adjust a reinforced concrete manhole, this work shall conform to the requirements and details as shown by the plans. Adjustment of brick manholes, brick stacks on reinforced concrete manholes and unreinforced concrete manholes with corbels will be paid for at the unit price bid for manholes adjusted. Adjustment of reinforced concrete manholes will be paid for at the unit price bid for reinforced concrete manholes adjusted.

E. Inlets Adjusted. - Inlets designated for adjustment shall be raised or lowered as necessary such that the top of the inlet will conform to the required elevation. Construction and material requirements shall conform to the same requirements as specified for new inlet construction. Adjustment of inlets will be paid for at the unit price bid for inlets adjusted.

F. Manholes Abandoned. - Manholes designated to be abandoned shall have the top four feet (4') removed and the remaining portion of the manhole

shall be filled with sand fill, flushed and vibrated. All pipes in the manhole which are to be abandoned shall be plugged prior to filling the manhole with sand. The top four feet (4') of the excavation shall be filled with material similar to the adjacent surface and compacted to a density of ninety percent (90%) of the standard density. Manhole castings shall be salvaged, cleaned and delivered to the City Maintenance Yard. The unit price stated in the Proposal shall cover all costs for completion of this item including excavation, backfill, compaction of backfill, salvaging castings and delivering castings to the City Maintenance Yard and disposal of debris. Pipe plugs will be paid for separately.

G. Connection To Existing Manholes Or Inlets. - When it is necessary to connect a new sewer to an existing inlet or manhole which does not have a stub to facilitate this connection, the Contractor shall break into the manhole or inlet carefully such that the structural integrity of the inlet or manhole will not be impaired. All repair work necessary to close the opening made to facilitate the installation of the new pipe shall conform to the requirements for new construction as specified in these specifications for the type of manhole or inlet involved. Waterstop gaskets shall be used when connecting A.B.S. Composite or P.V.C. Pipe to existing manholes to prevent leakage. The floor of the manhole or inlet shall be modified such that smooth channels will be formed from all inlet pipes to the outlet pipe such that the manhole or inlet will be self cleaning and free of areas where solids could be deposited as sewage flows through the structure.

No payment will be made for connecting new sewer pipes to existing manholes or inlets and all costs for completing this work shall be considered as subsidiary to the other items of work except when a bid item appears in the proposal for this work.

H. Pipe Plugs. - Both ends of all pipes to be abandoned in place shall be plugged. Pipe plugs shall be constructed of brick masonry. Pipes having diameters of eighteen inches (18") or smaller shall be plugged with masonry plugs eight inches (8") thick. Pipes having diameters of greater than eighteen inches (18") shall be plugged with masonry plugs twelve inches (12") thick. Construction requirements and materials for brick masonry plugs shall conform to the same requirements as specified for brick manholes.

Temporary pipe plugs on the ends of lines which are to be extended shall be prefabricated by the manufacturer of the pipe unless approved otherwise by the Engineer. Temporary plugs shall be of such construction that when they are installed, the plug will prevent entrance of any extraneous material into the sewer and such that will facilitate easy removal without undue damage to the sewer pipe when the sewer is extended.

Pipe plugs on sewers to be abandoned will be paid for at the unit price bid for pipe plugs. Temporary pipe plugs on sewers to be extended in the future will not be paid for directly and this cost shall be included in the price bid for the pipe.

I. Pavement Removal And Replacement. - The boundary lines of all pavement repair shall either terminate at existing pavement joints or at sawed cuts as directed by the Engineer. All lines of pavement removal shall be either perpendicular to or parallel with the centerline of the street or alley pavement. All pavement or driveway repair shall extend a minimum of one foot (1') beyond the edge of the sewer trench. No. 6 deformed reinforcing steel shall [be] placed across the sewer ditch on two-foot (2') centers with the bars extending a minimum of eleven inches (11") past the edges of the trench. Two No. 6 longitudinal reinforcing steel bars shall be placed parallel with the centerline of the trench for the full width of the pavement. All bar crossing [s] shall be securely fastened using wire ties. The pavement repair shall be two inches (2") thicker than the original pavement in an area of one foot (1') beyond either side of the sewer trench. The dimensions of pavement, curb, gutter, driveways and sidewalk shall conform to City Standards for that type of work even though those structures removed may not have originally conformed to such standards. Reconstruction of asphaltic concrete pavement shall conform to the City of Wichita Standard Specifications for asphaltic pavement construction. Reconstruction of concrete pavement shall conform to the City of Wichita Standard Specifications for concrete pavement construction.

Pavement removal will be paid for at the unit price bid for pavement removal and this price shall include all costs in connection with removing the pavement including any necessary sawing removal of any curbs or combined curb and gutter in connection with the pavement, and the removal or disposal of broken concrete. Sidewalk and driveway removal will be paid for at the unit price bid for walk and driveway removed and this price shall include all costs in connection with removing driveways and sidewalks including any necessary sawing, removal of any curbs in connection with driveways and the removal or disposal of broken concrete. Pavement replacement shall be paid for at the unit price bid for Pavement Replaced and this price shall include all cost for reconstruction of the pavement regardless of the type or thickness including reconstruction of any combined curb and gutter and/or curbs in connection with the pavement. Driveway replacement shall be paid for at the unit price bid for Drive Replaced and this price shall include all costs in connection with reconstruction of driveways including any curbs in connection with the driveways. Sidewalk replacement shall be paid for at the unit price bid for Walk Replaced and this price shall include all costs in connection with reconstruction of the sidewalk. Sidewalk and driveway construction shall conform with the applicable sections of the City of Wichita Standard Specifications.

J. Septic Tank System Removal . - If in the prosecution of the construction of any sanitary sewer it becomes necessary to remove a portion of or a complete septic tank, the inspector shall notify the Field Engineer and the Contractor or his representative, that if a portion of the tank is removed, the entire tank shall be removed and a temporary connection established. A change order must be executed for this extra work before the Contractor can proceed with the removal of the septic tank.

It will be necessary for the Contractor to obtain a permit for the temporary connection for which the normal fee will be waived and request

an inspection of the connection from the Engineering Sewer Inspector. All work in connection with the connection shall be in accordance with the code of the City of Wichita.

The Contractor shall notify the tenant or property owner that the septic system is removed and a temporary connection established and also inform the tenant or property owner that the Central Inspection Division shall be notified and requested to make an approved inspection of all plumbing in the building or residence. With this approval the connection will become permanent. All of the aforementioned shall be in accordance with the code of the City of Wichita.

In the event the lead line or the lateral from the septic system are encountered in the construction of the sewer, the Contractor shall make all necessary repairs for which no additional payment shall be made.

The inspector shall record on the daily record cards the location of the temporary connection as measured from a reference manhole and the side of the sewer where the temporary connection is made.

K. Tunnel Liner Installation. - Tunnel liner plates shall be used where specified by the plans. The cross section of the tunnel shall be circular and of the size indicated. Alternate sizes and shapes may be submitted for approval subject to it being best suited for proposed method of excavation and lining, the clear cross-sectional area shall not be less than the clear area of the circular section specified by the plans, and the invert shall be at a grade consistent with adjoining open cut construction.

Steel tunnel liner plates shall be Armco "Standard", Commercial Shearing and Stamping Co. "Commercial", Republic "Truscon Paneled Out", or an approved equal and shall be galvanized in accordance with A.S.T.M. A-123. The design and shape of the tunnel liner plates shall be such that assembly can take place entirely from within the tunnel liner. The minimum outside diameter shall be four feet (4') and the minimum wall thickness shall be United States Standard Gauge 12 (0-1046 inches). Sufficient sections shall be provided with one and one-half inches (1½") or larger grouting holes located near the center of the section so that when the plates are installed there will be one line of holes on either side of the tunnel and one at the crown. The holes in each line shall not be more than nine inches (9") apart and shall be staggered unless approved otherwise. Bolts and nuts shall conform to the applicable portions of A.S.T.M. Deisgnation A-153, A-307, A-325 and A-449.

Excavation of the tunnel shall be by approved methods consistent with the materials encountered. The sewer in the area to be tunneled shall be completed before the construction of adjacent portions of the same sewer so minor adjustments can be made in the adjacent sewer to compensate for slight discrepancies in alignment or grade which may occur in the tunnel construction. The liner plates shall be installed and assembled as the tunnel is excavated. The liner plates shall be installed such that the longitudinal joints in adjacent rings will be staggered. Longitudinal joints and circumferential joints shall all be

bolted joints. The excavation shall be accomplished in such a way that will prevent disturbing overlying material. Care shall be taken to maintain alignment grade and circular shape of the tunnel when the liner plates are installed. All voids between liner plates and surrounding earth shall be filled with grout forced in under pressure. The grout shall consist of two parts of sand to one part of Portland Cement mixed with sufficient water to maintain a freely pouring consistency. Grouting holes shall be plugged as soon as the voids are filled in that section to prevent the grout from flowing back out. The lining shall be cleaned of all debris after its installation is complete and all leaks which allow flowing or seeping water into the tunnel shall be plugged. The annular space between the sewer pipe and the tunnel liner shall be filled with sand from end seal to end seal after the sewer pipe has been permanently placed in the tunnel, tested and approved, in such a manner such as not to disturb the alignment or grade of the sewer pipe. Brick masonry end seals eight inches (8") in thickness shall be constructed on each end of the tunnel after the sewer pipe has been installed, tested and approved. Brick, mortar, and construction requirements shall conform to the same requirements as specified for brick manholes.

The Unit price named in the Proposal shall cover all costs for completion of this item including excavation, liner plates, sand fill, end seals, grouting, skids, bands, fittings, backfill and compaction of backfill. Sewer pipe installed in the tunnel will be paid for separately at the unit price stated in the Proposal.

L. Sewer Installation By Boring And Jacking Methods. - Steel casing or sewer pipes shall be installed by boring and jacking methods where specified by the plans. Pipe to be bored and jacked shall be as specified by the plans. Steel casing for bored and jacked construction shall be steel pipe conforming to A.S.T.M. Designation A-139 with a minimum diameter as shown on the plans. Steel shall be Grade B under railroads and Grade A on all other uses. Steel pipe shall have welded joints in accordance with A.W.W.A. C-206 and shall have minimum wall thickness as indicated in the following table.

Diameter of Casing - inches	Nominal Wall Thickness - inches	
	Under Railroads	All Other Uses
16	0.281	0.188
18	0.312	0.250
20	0.344	0.250
22	0.375	0.250
24	0.406	0.281
26	0.438	0.281
28	0.469	0.312
30	0.469	0.312
32	0.500	0.312
34	0.500	0.312
36	0.500	0.344

Excavation shall be completed by approved methods applicable to the materials encountered. The sewer in the area to be bored and jacked shall be completed before the construction of adjacent portions of the

same sewer so minor adjustments can be made in the adjacent sewer to compensate for slight discrepancies in alignment or grade which may occur in the boring and jacking process. Boring and jacking operations shall be performed by experienced crews using a rotary type boring machine designed especially for this purpose. The casing or pipe shall be jacked as the boring proceeds. Boring without simultaneous jacking of the casing or pipe will not be permitted.

The steel casing or sewer pipe shall be cleaned of all debris after its installation is complete. The annular space between the steel casing and the sewer pipe shall be filled with sand from end seal to end seal after the sewer pipe has been permanently placed in the casing, tested and approved, in such a manner such as not to disturb the alignment or grade of the sewer pipe. Brick masonry end seals eight inches (8") in thickness shall be constructed on each end of the casing after the sewer pipe has been installed, tested and approved. Brick, mortar and construction requirements shall conform to the same requirements as specified for brick manholes.

The unit price named in the Proposal for steel casing bored and jacked shall cover all costs for completion of this item including excavation, steel casing, sand fill, end seals, skids, bands, fittings, backfill and compaction of backfill. Sewer pipe installed in the steel casing will be paid for separately at the unit price stated in the Proposal.

Pipe bored and jacked will be paid for at the unit price named in the Proposal, unless indicated otherwise by the plans. This price shall include all costs for completion of this item including pipe, excavation, backfill and compaction of backfill.

M. Reinforced Concrete Encasement. - Reinforced concrete encasement shall be constructed to conform with the standard detail drawing. Concrete and reinforcing steel used in the construction of reinforced concrete encasement shall conform to the requirements as specified in the Standard Specifications for concrete pavement construction. Reinforced concrete encasement constructed on clay pipe shall begin and/or terminate at joints in the pipe when the encasement does not start or stop at a manhole. The encasement shall start or terminate in such a manner as will maintain the flexibility of the joint in the clay pipe. Reinforced concrete encasement will be paid for at the price bid per lineal foot for the various pipe sizes indicated. This price shall include all costs for material, labor, equipment, excavation, backfilling and any other incidentals necessary to complete the work.

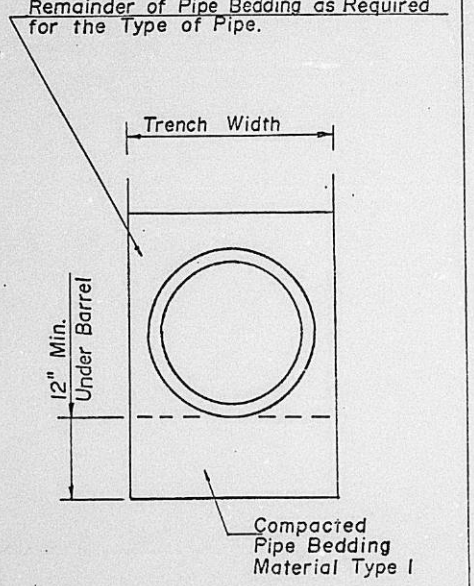
N. Reinforced Concrete Cradle. - Reinforced concrete cradle shall be constructed to conform with the standard detail drawing. Concrete and reinforcing steel used in the construction of reinforced concrete cradle shall conform to the requirements as specified in the Standard Specifications for concrete pavement construction. Reinforced concrete cradle constructed on clay pipe shall begin and/or terminate at joints in the pipe when the cradle does not start or stop at a manhole. The cradle shall start or terminate in such a manner as will maintain the flexibility of the joint in the clay pipe. Reinforced concrete cradle will

be paid for at the price bid per lineal foot for the various pipe sizes indicated. This price shall include all costs for material labor, equipment, excavation, backfilling and any other incidentals necessary to complete the work.

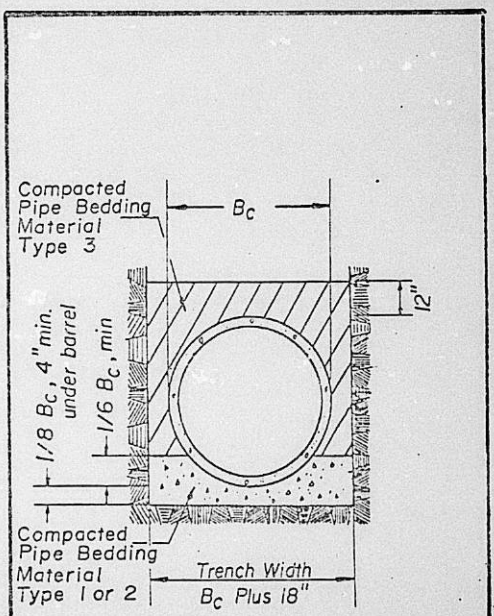
O. Building Sewer Lines. - Any work involved with building sewer lines, which usually are four-inch (4") or six-inch (6") lines, shall be completed in conformance with the applicable sections of the City of Wichita Code. Permits must always be taken out for any work on building sewer lines. Such permits are obtained from the Central Inspection Division on the 7th Floor of the City Building at Main Street and Central Avenue. Fees for such permits will be waived if the work to be completed is to be inspected by the Engineering Department. The normal fee will be charged for such permits only when it is necessary that the work to be completed must be inspected by the Building Sewer Inspectors of the Central Inspection Division. When building sewer work is such that would require a tap be made in any rigid sewer line such as clay or concrete, the Contractor will request Sewer Maintenance Division to make the tap. The Contractor will be required to pay the normal fee for such tap. Building sewer line construction and/or reconstruction shall be paid for at the price bid per lineal foot of pipe for the various sizes and types indicated. This price shall include the cost of all material, labor, equipment, excavation, backfilling and other incidentals necessary to complete the work in conformance with the City Code. Traps and clean outs shall be measured and paid for as lineal feet of pipe for the various sizes and types indicated. Building sewer connections made to sewer lines eight inches (8") or larger shall be paid for at the price bid for Building Sewer Connection. This price shall include all costs for connecting the building sewer including material, labor, equipment, excavation, backfilling, tapping fee when necessary, saddle fitting and any other incidentals necessary to complete the work.

P. Riser Pipe. - Riser pipe shall be installed to serve individual lots or tracts in conjunction with new sanitary sewer construction, unless otherwise ordered by the Engineer, because of ground water, unstable soil or unusually deep construction. Riser locations shall be as approved by the property owner with the concurrence of the Engineer. Installation of risers on sewers because of unusual depth will be required when the sewer is deeper than twelve feet (12'). The Contractor will be required to file written documentation with the Engineer in a form approved by the Engineer indicating the locations where risers are to be installed as requested by the property owner or his authorized representative. Riser pipe construction shall conform to the requirements as shown on the standard riser detail sheet. Installation of risers shall be paid for at the unit price bid per lineal foot for riser pipe and reinforced concrete encasement for the various pipe sizes indicated. These prices shall cover all costs including material, labor, equipment, excavation, backfilling and any other incidental [s] necessary to complete the work. Contract quantities pertaining to riser installation may or may not be utilized on the project based on the decision of the Engineer with regards to trench conditions. It should be understood by the Contractor that the necessity for installation of risers and the final pay quantity for such work will largely depend on job conditions and may vary greatly from contract quantity or may not even be utilized at all and, therefore, the Contractor should prepare his bid in accordance with these conditions.

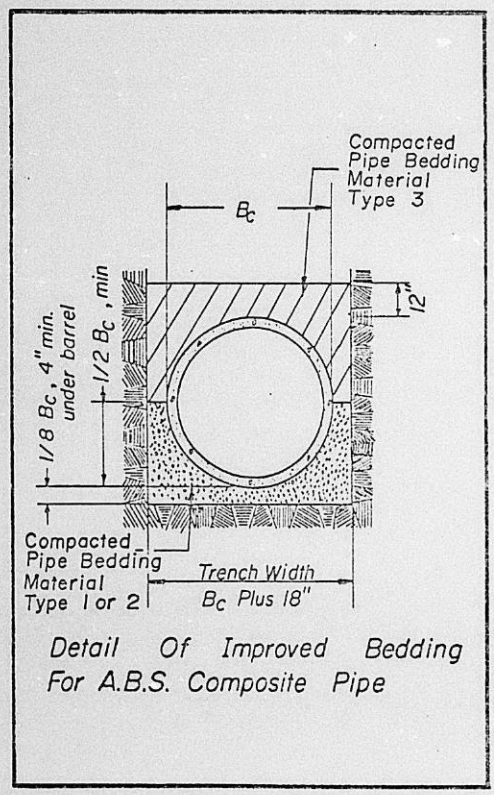
[Q. Pipe Stub-Outs. - Four-inch (4") and six-inch (6") pipe stubs with temporary pipe plugs shall be installed in manholes when shown by the plans or when directed by the Engineer to facilitate connection of building service lines. All four-inch (4") and six-inch (6") stubs shall be extra strength clay pipe conforming with the latest revision of A.S.T.M. Designation C-700. Four-inch (4") and six-inch (6") P.V.C. or A.B.S. pipe shall be S.D.R. 23.5 pipe. Four-inch (4") stubs shall be paid for at the price bid for each four-inch (4") stub installed as approved by the Engineer. Six-inch (6") stubs shall be paid for at the price bid for each six-inch (6") stub installed as approved by the Engineer.]



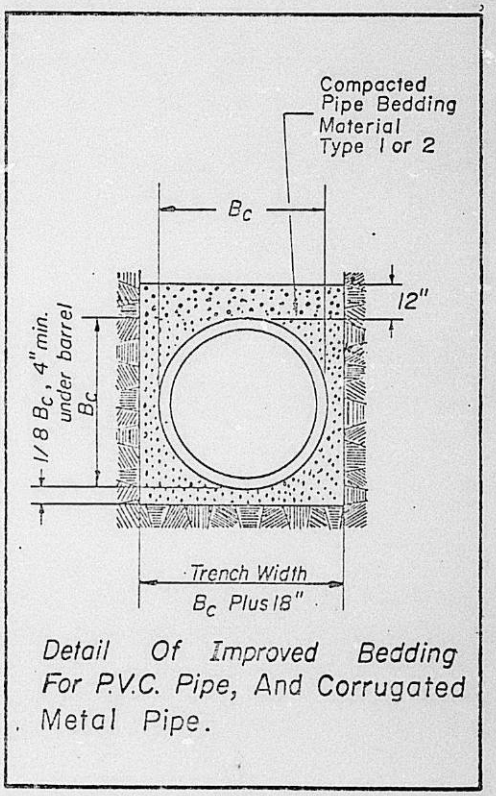
Detail of Trench Stabilization, Required When Trench is Wet or Unstable or When Dewatering is Required.



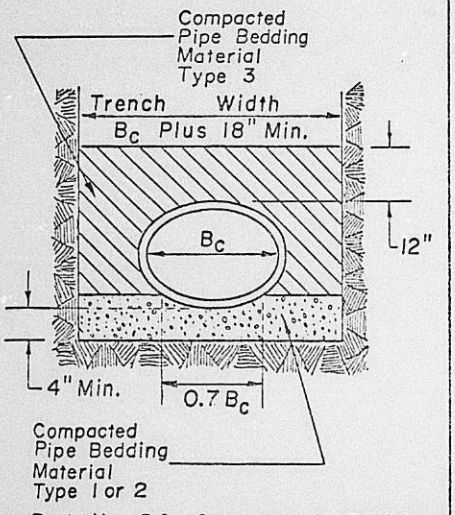
Detail Of Improved Bedding For All Types of Pipe Except A.B.S. Composite Pipe, P.V.C. Pipe And Corrugated Metal Pipe.



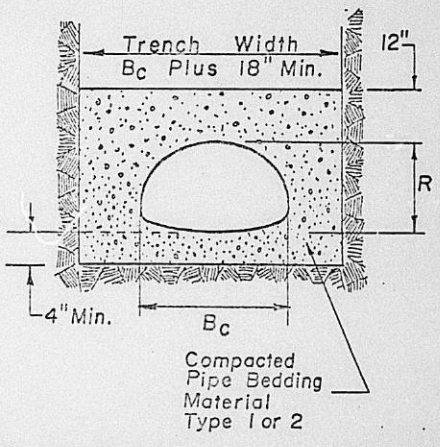
Detail Of Improved Bedding For A.B.S. Composite Pipe



Detail Of Improved Bedding For P.V.C. Pipe, And Corrugated Metal Pipe.



Detail Of Improved Bedding
For Concrete Elliptical Pipe



Detail Of Improved Bedding
For Corrugated Metal Arch Pipe

DR 82-23

FILE COPY

WICHITA-SEDGWICK COUNTY
METROPOLITAN AREA PLANNING COMMISSION
AND THE
ECONOMIC DEVELOPMENT COMMISSION

Cost-Effectiveness Study on Storm Sewer Pipe Materials

Submitted by:

Task Force
on
Storm Sewer Pipe Materials

TABLE OF CONTENTS

TO Economic Development Commission
Metropolitan Area Planning Commission

FROM Task Force on Storm Sewer Pipe

The attached report constitutes not only the efforts of the Members of the Task Force, but of City and County staff members, various suppliers of pipe materials and the faithful members of the audience who participated in the numerous, and on occasion, lengthy meetings. The report will not please all parties, but the Task Force believes that it is a good conservative approach to providing equality between corrugated steel storm sewer pipe and concrete storm sewer pipe based on information and experience available. It is unfortunate that some other types of available materials have not been used in controlled situations so that local experience could be gained. To this end, the Task Force recommends that some test installations be made in order to get some first-hand experience where the available information indicates that other materials have merit. Some of those materials are discussed briefly in this Report.

When the Task Force was appointed, it was asked to study and report on four sub-elements. Those four, Hydraulic Equivalence, Service Life, Installation Specifications, and Maintenance, were studied and debated at considerable length, and the report transmitted herewith distills that study. Careful comparison of the charge given the Task Force with respect to installation specifications and this report will reveal that although considerable material was considered by the Task Force, it became apparent to its members that a major rewriting of the City of Wichita specifications for installation of storm water sewers, to account for flexible pipe systems, is beyond the capabilities of the Task Force. Most of the Task Force discussion on specifications took place without benefit of review of revisions to the "Specifications For Sanitary and Storm Sewers" which are dated March 1982, but due to printing delays, were not available to the Task Force until May. The changes included in that edition do not separate the methods to be used to install or specify the performance expected from the rigid and flexible systems and are somewhat ambiguous as to what applies to storm sewers and what applies to sanitary sewers. Most of the Task Force members have experience in writing and assembling specifications for public contracts and feel that the questions raised during the Task Force study can only be answered by a major rewriting and that such an undertaking should be by a consultant who is experienced with pipe laying work in Wichita; who has access to technical experts in several fields; has access to legal review of the work, and finally, has experience in developing and keeping up-to-date technical specifications for storm water sewers.

The Task Force feels that it should be reconvened after sufficient time has elapsed in which to put into effect those recommendations which are ultimately adopted and/or approved. In this way, a determination can be made of the results of the recommedations and if those results are those expected by the Task Force.

The Task Force wishes to thank the Economic Development Commission and the Metropolitan Area Planning Commission for the opportunity to serve the two Commissions.

George H. Wilton

George H. Wilton, P.E.
Task Force Chairman

GHW:vn
Attachment

ACKNOWLEDGEMENTS

The Task Force wishes to thank the following individuals for their cooperation and participation in the study, and in particular, for furnishing data and information which contributed to the conclusions and recommendations reached in this study.

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GLOSSARY

AASHTO.....	American Association of State Highway and Transportation Officials.
Annular Pipe.....	Where the Corrugations Run Annularly Around the Pipe.
APWA.....	American Public Works Association.
ASCE.....	American Society of Civil Engineers.
Bedding.....	Material on Which the Pipe is Supported.
CAP.....	Corrugated Aluminum Pipe.
CMP.....	Corrugated Metal Pipe.
CSP.....	Corrugated Steel Pipe.
Deflection Limit.....	Maximum Allowable Decrease in Diameter or Rise of Sewer Pipe, Including Allowable Manufacturers Tolerance.
Flushing.....	Flooding of the Backfill With Water to Secure Settlement.
Helical Pipe.....	Where the Corrugations and Seams Run Helically Around the Pipe.
Jetting.....	The Use of Water to Secure Settlement of the Backfill by Introducing Water Through Jets Beginning With the Lower Extremities of the Fill.
Load Factor.....	The Ratio of the Supporting Strength in an Actual Field Installation to the Strength as Determined in the Laboratory by Means of a Three-edge Bearing Test.
N or n.....	A Roughness Coefficient in the Manning Formula Representing the Effect of Pipe Roughness on Energy Losses in the Flow.
Plain Corrugated Steel Pipe.....	Where Only a Zinc or Galvanized Coating Has Been Applied.
RCP.....	Reinforced Concrete Pipe.
Reformed Ends.....	Where the Ends of Helically Corrugated Pipe Have Been Reformed to Annular Corrugations.
Service Life.....	The Length of Time that A Storm Sewer System Should Function Without Major Repair.
Test Installation.....	A Limited Installation of Storm Sewer Pipe for the Purpose of Studying its Hydraulic Capabilities, Service Life, Installation Problems, or Costs Under Varying Conditions. The Length of the Installation Should be Sufficient to Evaluate as a Storm Sewer, and Not as an Inlet Lead, and Should Begin and End at Manholes or Terminate at the Outfall End of the Line.

I INTRODUCTION

A. Responsibility of the Task Force

The Task Force was appointed by the Board of Land Use Economics and the Metropolitan Area Planning Commission, to study the cost-effectiveness of different types of pipe material available for use in the construction of storm sewers in the City of Wichita. To this end, the following four sub-elements were identified:

1. Hydraulic Equivalence - A comparison of capacities of various sizes of steel and concrete pipe under various installation conditions, coatings, and linings.

2. Service Life - A collection of data showing expected and/or actual service life of concrete and steel pipe.

3. Installation Specifications - A comparison of the installation requirements for concrete and steel pipe including load-carrying capacities and estimated costs.

4. Maintenance - A comparison of the various maintenance problems and costs associated with the two types of pipe.

The Task Force was organized into study groups in order to individually study these sub-elements or issues.

Representatives of the manufacturers of several different types of pipe were provided the opportunity to address the Task Force as a whole on each of the sub-elements and to furnish any information they deemed pertinent to the study. In addition, product manufacturers addressed

the individual study groups and provided them with more specific information relating to their sub-element assignments. The printed material provided is much too voluminous to include in this report, but we have filed a copy of the information submitted with the Planning Department. The Task Force has not hesitated to borrow from this material during the preparation of this report.

B. History of Storm Sewer Pipe Installations

Early storm sewer installations were vitrified clay tile up to 36 inches in diameter. Larger lines were constructed of brick or segmented tile in place. In a few cases brick was used for lines as small as 30 inches. These early lines have proven to be most durable with many still in service and only subject to replacement when major street reconstruction takes place.

The records indicate that the City began using concrete pipe in 1930. Some vitrified clay tile continued to be used into the early 1940s, mostly in catch basin leads.

Although the City had used corrugated steel pipe in culvert installations and for outfall lines into creeks for many years, it was not until 1972, that a storm sewer line of any length was constructed of corrugated steel pipe. There are no reliable records on the use of corrugated steel pipe for culvert and outfall installation inasmuch as most, if not all, were considered to be of a temporary nature. The exception being, those corrugated steel pipes used as part of the Wichita-Valley Center Flood Control Project.

City maintenance records indicate that 200 miles of storm sewer are currently being maintained. This inventory may not include some lines constructed as incidental drainage or by the State. The records do not reflect a breakdown by type of material, but a majority of the system is reinforced concrete pipe. In our study for this report we did verify the existence of about 12 miles of corrugated steel pipe.

A. Conclusions

1. Most information furnished to the Task Force regarding CSP has been based on analysis of culvert installations, not from studies of sewer installations.

2. The sizing of alternate pipe material can be accomplished using the chart included for such purposes provided checks are made to be certain minimum velocity and cover is maintained. In most cases, a separate and completely new design will be necessary.

3. Asphaltic coating on fully paved steel pipe is not of sufficient durability to warrant it's use for the purpose of a lower "N" value.

4. The use of lower "N" values for helically corrugated steel pipe is not deemed advisable, because the debris carried in the flow, the deposits in the pipe, and the interuptions to the flow caused by reformed pipe ends to make a joint and by manholes does not permit the ideal flow conditions necessary to make the lower "N" values applicable.

5. Asphaltic coating of steel pipe does not significantly extend the service life of the pipe.

6. The use of washed sand material as backfill around steel pipe will protect against external corrosion.

7. The service life of concrete and steel pipe can be made more nearly equal by specifying a thicker walled steel pipe than is required for strength alone.

8. Many of the problems discovered while examining various storm sewer installations could have been averted or corrected at the contractor's cost by more stringent enforcement of the contract documents.

9. Maintenance of ceramic and concrete pipe storm water sewers in Wichita has not required a major effort or expenditure to preserve the capacity for which they were designed and constructed.

10. The level of maintenance of the ceramic and concrete pipe storm water sewer system was adequate and appropriate, with rare exceptions, to protect and preserve the public investment in it.

11. The collection of dirt and other debris appears to be more prominent in the unpaved corrugated steel pipe than in the smooth concrete. Cleaning of the unpaved corrugated steel pipe will be required more frequently and such cleaning will pose more of a danger to the pipe itself.

12. Repair of construction related and encroachment damage to plain CSP storm water sewers will not lend itself to internal repair equipment or practices and probably will require excavation, removal of

the damaged portion and welding or banding a replacement section in place. Where the damaged CSP is beneath pavement and in an area of high utility line density, cost for traffic diversion, safety measures, pavement removal and replacement, shoring and support of exposed utilities will add to the cost of CSP repair.

13. Arriving at a comparison of different pipe materials on an annual cost effective basis was not deemed appropriate by the Task Force. It was decided the best approach was to provide for pipe materials which were as nearly equal as possible in terms of service life. Other factors can be taken care of by design and bids.

14. Providing for alternative pipe material for competitive purposes only can be, in the long run, a costly decision. Each and every pipe material can, at some time, be the best suited for a particular installation and should be specified. In those situations where alternate pipe material can be specified, the predicted service life of the alternates must be near equal.

C. Recommendations

1. Prior to final acceptance of a storm sewer project from the contractor a final check should be made of the completed project by personnel of the Sewer Maintenance Division for defects in the installation or materials using television for the smaller lines and by visual inspection for the larger lines. The

costs should be charged to the project as is now the case with sanitary sewers.

2. The design of storm sewers should provide for a minimum cleansing velocity of 2 (fps) at a depth of 0.2 of the diameter or rise of the pipe.

3. Training seminars for construction inspectors should be initiated, possibly through the American Public Works Association, but with major training contributions by representatives of the various manufacturers of pipe materials used by the City. These training seminars should also be attended by design engineers, but more advanced courses in design should be made available to them.

4. Bedding and backfill specifications were improved during the Task Force study period. However, they need to be improved where corrugated steel pipe is used to require complete sand or gravel encasement, thereby providing protection against external corrosion as is now the practice in water line installations. The standard detail shown on page 39 of the City of Wichita Proposals and Specifications for Sanitary and Storm Sewers, should be revised to require the compacted granular material to be brought to a point 12 inches above the top of pipe and the heading revised to read "Detail of Improved Bedding For PVC and Corrugated Steel Pipe." The heading for the detail on page 37, will have to be revised to include Corrugated Steel Pipe as one of the exceptions.

5. The specifications should include a deflection limit of five percent of the nominal diameter of corrugated steel pipe. A deflection greater than 5 percent should result in the contractor reconstructing that section of line.

6. The use of jetting or flushing should not be allowed for compaction of backfill on corrugated steel pipe installations. Only hand or mechanical tamping of backfill placed in layers should be allowed.

7. Although the Task Force was assured that corrugated steel pipe can be furnished in any size in one-inch increments, a problem could arise in securing the proper size for making a repair or an extension if other than standard sizes are specified. The Task Force, therefore, recommends that only standard sizes be specified.

8. The Task Force recommends that storm sewer pipe, of materials other than those currently in use by the City, be specified for test installations of 300-600 feet where research indicates that the material has merit. The test installations could be a selected part of a project where the effects on the overall project were negligible. It is not the intent of this recommendation to restrict the study of the new material to one installation, but to encourage installations under varying conditions, so that an accurate and complete evaluation can be made.

9. In order to help in the fight against corrosion, the ungalvanized welds and pipe ends should be factory painted and any areas where the galvanizing has been damaged in shipping or installation should be field-painted.

10. The Task Force recommends that gaskets be specified with hugger bands on all corrugated steel pipe joints to insure a proper and water-tight joint.

11. In order to make the service life of corrugated steel acceptable, the minimum allowable thickness should be established at 0.109 inches or 12 gauge.

12. The Task Force does not believe that the bituminous coatings and paving are accomplishing the purposes for which they have been specified; therefore, it is recommended that they no longer be permitted.

13. That a program of routine inspection of corrugated steel pipe storm sewers and test installations of other materials be initiated to provide a record on which to base future changes in sewer maintenance policy or construction material specifications. The inspections should be made by teams consisting of members from the Sewer Maintenance Division and the Engineering Department.

14. That the Task Force, after a reasonable period in which to implement the recommendations, be reconvened to determine, if, in fact, the recommendations have been implemented and are working as anticipated by the Task Force.

15. That the specifications for storm and sanitary sewers be rewritten to spell out in more detail that which the contractor is expected to do, and the results which he is expected to obtain and in the process, the specifications for storm and sanitary sewers be separated to eliminate the confusion which now exists in determining which parts are applicable to each kind of sewer. The Task Force further recommends,

that separate specifications be written for rigid and for flexible pipe.

16. That the Manning's Friction Factors (n) shown in the Appendix be adopted.

III HYDRAULIC EQUIVALENCE

Since velocities for storm water sewers are based on Manning's Formula ($V = \frac{1.49}{n} R^{2/3} S^{1/2}$), which is universally accepted by most governmental agencies, municipalities, and consultants, it is then apparent that the coefficient of roughness, or Manning's "n", will determine the capacity of any storm sewer with a given diameter, slope and flowing full.

Values of Manning's "n" were studied in numerous textbooks, handbooks produced by affected associations and from studies prepared by nearby municipalities. Values utilized by the Kansas Department of Transportation and those currently being used by the City of Wichita were also reviewed. It was determined that in the area of normal practicality, there was little variation in values used or proposed.

The values currently under use by the City of Wichita were found to be acceptable, but are, perhaps too refined for the usual degree of accuracy expected from normal hydrology and hydraulic equations. The Task Force did, however, question the coefficients assigned helical pipe and proposes modified values to reflect the Task Force's thinking.

Although the Task Force attempted to pursue a course which would permit alternate materials to be specified on the basis of only one design--which is the current practice--it soon became evident that this would not be possible. This is because, if the alternate materials have a wide difference in roughness coefficients, there will be a marked effect on velocities at the same slope. There can also be a problem with the physical installation of a larger pipe of equivalent

capacity because of lack of cover or interference with other utilities. Even though it is possible to prepare simple graphs showing pipe sizes for equivalent capacities, as have been included in the Appendix, the designer must check physical considerations and velocities to be sure that clearances are there for a larger pipe and minimum velocity is maintained. It will be necessary, in most cases, to make two designs if alternate pipe materials are to be specified.

The Task Force, after reviewing available literature and television tapes of existing sewer installations, is of the opinion that in order to avoid--as much as possible--the collection of silt and debris in the lines, a minimum cleansing velocity of 2fps at a depth of 0.2-full, should be adopted.

IV SERVICE LIFE

The first step to be taken during a discussion of Service Life, is to define the expression "Service Life." Based on the Task Force's study of numerous reports, letters, pictures and books, the following definition of Service Life was derived: "The length of time that a storm sewer system should function without major repairs or replacement."

The next step is to determine the minimum service life for which a storm sewer should be designed: A 1971 study by the Research Division of the Department of Planning and Development of the State of Kansas, concluded that a life of 40 to 50 years or more may be anticipated for normal galvanized steel pipe culverts in Kansas. This anticipated service life was applicable to most locations in Kansas except those near active coal mines. A majority of the pipes in this study were 16 gauge and 24 inches or less in diameter. A 1973 survey of 14 cities in the southeastern United States indicated that 71 percent of the surveyed cities accepted a 50-year use for a storm sewer. The Handbook of Steel Drainage and Highway Construction Products, estimates years to perforation of the invert of 16-gauge plain galvanized corrugated steel pipe in normal water (pH $\geq$ 5.8) to be 49 years. The Sewer Manual for Corrugated Steel Pipe, by the National Corrugated Steel Pipe Association, references a study conducted by the Los Angeles County Flood Control District, on CSP storm drains, which concluded that the crown zone of CSP could be assigned a service life of 100 years, provided an exterior coating was applied. The 1958 Edition of the Concrete Pipe Handbook, prepared by the American Concrete Pipe Association (ACPA), states that the universally accepted

life expectancy of a concrete pipe culvert is 100 years. Black and Veatch, Consulting Engineers, normally utilizes reinforced concrete pipe for storm sewers, and believes that its service life is almost indefinite. It is the opinion of the concrete pipe industry that concrete pipe has a useful service life of between 75 and 100 years. These sources are just a few of the opinions and statements that were found on this subject. Perhaps the service life of the structure, road or street which the storm sewer complements should govern. For example, the Federal Highway Administration requires a 50-year design life for interstate highways and this also applies to culverts.

The study prepared for the City of Wichita and Sedgwick County entitled "Pavement Design and Feasibility Study for Residential Streets Within the Wichita Metropolitan Area" defines the design life of pavement as the period of time in years for which the volume and type of traffic and the resultant wheel or axle loads are forecast, and on which, the structural design of the pavement is calculated and an acceptable driving surface provided without major maintenance. The study defines service life as the period of time the pavement will provide, with periodic maintenance, such as patching, and/or overlays, an acceptable riding surface for the traffic. The study points out that at the end of the design life the service life will be extended by an overlay which will last 20 years. It is apparent that as long as the base is sound, resurfacing by means of stripping and overlaying or by use of repaving machines such as the Cutler Repaver, the service life can be extended much beyond the design life.

If a service life expectancy could be assigned to each pipe, then it would be possible to compare these on a long term

economic basis, such as a cost-effective life-cycle, present-worth method. Another option that we have is to study the various methods of increasing the service life of corrugated steel pipe in order to make it an equal alternate storm sewer material. We also have the option to recommend that we maintain the status-quo or that corrugated steel pipe be removed from the plans and specifications. The Task Force, after careful deliberation, believes that the proper approach to this issue is to recommend ways of making corrugated steel pipe an equal alternate storm sewer material.

There are various methods of extending the service life, of corrugated steel pipe. These are: proper construction practices, soil corrosion protection, increase of metal thickness and the use of protective coatings and pavings.

The Task Force had the opportunity to view recent photographs of S.W.D. No. 25 in Harry Street, east of Airport Road, and the North Wichita Industrial Park storm sewer in 33rd Street North from St. Francis to Mead. These projects had some fully paved sections and it was apparent that some of the coating was beginning to fail. It could also be observed that piles of material, probably backfill, had infiltrated at some of the joints. The Task Force feels that most of this infiltration could have been eliminated with proper installation techniques and better construction inspection. Corrugated metal pipe is a flexible conduit that depends upon passive soil pressure for its design strength. This requires very meticulous backfill procedures to be specified and completed during construction. It was noted, that the pictures of the stacked pipe on the Ridge Road and Maple project, showed corrosion at the ungalvanized pipe ends. The possible solution to this problem could be field painting prior to installation.

Soil corrosion is best determined by its pH (hydrogen ion concentration) and its electrical resistivity (which indicates the relative quantity of soluble salts). For example, sea water has a resistivity of about 90 ohm centimeters, whereas ordinary tap water will usually be in the range of 10,000 ohm centimeters or higher. Soils and water with pH of 5.8 or more is considered normal, and pH of less than 5.8 is classified as acidic. Soils with an electrical resistivity of 0-2000 are considered to have a bad corrosion resistance, whereas anything above 4500 is considered good. In general, sand and granular backfills will have resistivity values of 8000 ohm/cm and higher. Perhaps an economical method to combat soil-side corrosion is by the use of sand and granular backfills. It is interesting to note that in the Kansas Study of Corrosion of Corrugated Metal Pipe, 1971, that 90 percent of the resistivities were between 700 and 2300 ohm/cm.

The most common types of protective coatings are zinc coatings (galvanizing), asphalt coating (plain and asbestos bonded), and polymeric or plastic coatings. Fully paved asphalt linings have been used in Wichita and the results have not been too encouraging. The most common problem appears to be the failure of the asphalt lining to adhere to the metal base.

There is a coating process which has been available for many years called "Asbestos Bonded Bituminous Coating." It has fibers of asbestos felt embedded in the galvanized coating of sheet steel which enable the bituminous coating or paving to adhere more tenaciously to the metal base. The American Iron and Steel Institute and the Utah State De-

partment of Highways report that the service life of asbestos bonded fully paved and coated corrugated metal pipe can be extended at least 25 years over the plain galvanized pipe. The Ohio Department of Transportation states that asbestos bonded bituminous coating and paving has performed very well and seems to have corrected the problem of adherence of bituminous protection. A report in 1976 by the Battelle Columbus Laboratories of Columbus, Ohio, stated that all of the asbestos bonded pipes with 35-36 years of service were reported to be in "very satisfactory condition", and the coating was reported to be "intact" or "like new." Asbestos bonding is a coating system which has been around a long time, is very dependable--according to the above sources--but apparently has never been used here.

Another way the Task Force believes corrugated steel pipe can be made a more equal storm sewer material, is to increase the base metal thickness. The American Iron and Steel Institute uses a corrosion-abrasion rate of 0.0013 inches per year for normal conditions ($pH \geq 5.8$). At that rate, it would take 84 years to perforate a wall thickness of .109 inches (12 gauge). The Task Force is of the opinion that increasing the thickness of the base metal is a more positive way to predict the service life of the corrugated steel pipe than is the use of asbestos bonded bituminous coatings.

During the study of service life, data became available on corrugated steel pipe with an aluminized coating rather than a galvanized coating, corrugated aluminum pipe and "Spriolite", a high-density polyethylene pipe. Presentations were made by representatives of the manufacturers of these three products and literature was obtained.

Aluminized corrugated steel pipe has been around for sometime, but none has been installed by the City of Wichita. Aluminized steel is a proprietary item of ARMCO, Incorporated, but it has recently been made available to other pipe makers. ARMCO makes some strong claims as to service life, as much as 75-100 years, but this is disputed by other steel manufacturers. The area of contention revolves around the ability of the aluminum to protect the base steel when the surface coat of aluminum has been scratched or otherwise broken. The claims are that the aluminum surface does not tend to "heal" itself as does the galvanized surface.

Corrugated aluminum pipe has also been around for sometime, but the City does not have any in place. Claims for service life are high, 75-100 years and more. Hydraulically, corrugated steel and aluminum are the same.

The material of which "Spirolite" is made, a high-density polyethylene material, has been used by the City for sanitary sewer applications with success to date, but this does not automatically mean that it would be as successful for a storm sewer application.

The Task Force is of the opinion that these products should be tested on a limited basis. This could perhaps best be done by specifying these materials for use on selected incidental drainage projects.

V INSTALLATION SPECIFICATIONS

Obviously those who were involved in the decision to permit the use of corrugated steel pipe as an alternate material for use in the construction of storm sewers, envisioned construction of corrugated steel pipe storm sewer systems with comparable quality of construction, hydraulic efficiency and service life to that which was known to be attainable with concrete pipe. Representatives of the corrugated steel pipe industry provided much information to those involved with making this decision. They gave testament to a high quality type construction of storm sewer systems utilizing corrugated steel pipe. However, photographs recently reviewed by this Task Force indicate that the quality type of corrugated steel pipe storm sewer systems envisioned by those responsible for making the decision to permit use of this material as an alternative to concrete pipe is <u>not</u> being attained. Recent photographs also viewed by this Task Force seems to indicate many like problems with concrete pipe storm sewers. The old cliche "the proof of the pudding is in the eating thereof", appears to be applicable in this situation. The "pudding" has now been tasted and the flavor appears to be less than the quality desired. The question now which appears before this Task Force is whether or not the "recipe" can be upgraded to produce the quality of "flavor" desired in the "pudding". This document will address installation specifications as one aspect of the "receipe" for quality storm sewer construction.

An understanding of the environment within which the specification writer must function is necessary prior to passing judgement on the adequacy of written specifications. Some

of the constraints, facts and assumptions which must be considered by the specification writer are as follows:

1. The specification writer assumes that the work to be completed for which the specifications are prepared will be constructed by a qualified competent contractor with thorough knowledge and expertise for that type of construction contemplated.

2. The specification writer assumes that the work to be completed for which the specifications are prepared will be inspected by qualified competent inspectors with thorough knowledge and expertise for that type of construction contemplated.

3. Problems have long been acknowledged in verbal and written communications from one person to another. The message sent is frequently misconstrued by the person receiving it. Many people are familiar with the parlor game where a simple message contained in a single sentence is to be passed from one person to another through a group of people. The final message received by the last participant is often times quite different from the message initially sent.

   This parlor game bears out the fact that the more complex the initial message, the greater the likelihood that the message received by the last participant will be severely garbled.

4. It is accepted practice that standard specifications do not describe in intricate detail every exacting movement and procedure required to physically complete the work.

Legal precedance exists whereby the courts have determined that specifications cannot legally bind a contractor to one special mode of operation when other modes of operation may possibly be used with the same end result. The specifications must, however, spell out in sufficient detail the results expected, and if the results expected are not obtained, then the specifications should provide a means for correcting the problem. All specifications are written with the intent that when the specifications omit a detailed description of an operation or procedure, the best accepted general practice shall be followed.

5. Standard specifications are not written to cover all cases in all circumstances. Frequently special provisions must be incorporated into the project contract documents covering unusual conditions which are not covered by the standard specifications.

6. Occassionally specifications describe a material product by using the name of a proprietary product or the name of a particular manufacturer to establish the type, function and quality desired with the addition of the phrase "or approved equal."

7. The American Society of Civil Engineers (ASCE) Manual of Practice No. 37, states "The ingenuities of the owner, engineer and contractor must be applied continually if construction costs are to be minimized and a quality job is to result. It is important to note, however, that the engineer's representative on the site is not expected to duplicate the detailed inspection of material and workmanship properly delegated to the manufacturer, supplier, and contractor". Toward this

objective, this Task Force encourages the City of Wichita in its efforts to provide American Public Association (APWA) training seminars for its construction inspectors. Contractor's field superintendents should also be encouraged to participate in this type of training. Manufacturers and Engineers also should exercise their responsibility for sharing their knowledge and expertise with the personnel involved in actual construction.

During discussions of this portion of the study it became evident that the majority of the Task Force desired more stringent specifications than now used by the City. Particular areas of concern were:

1. Final examination of the system prior to acceptance from the contractor. Final inspection procedures should be adopted such that the interior of all storm sewer pipes are visually inspected prior to acceptance of the project. The contractor should then be required to repair or replace any damaged pipe noted in the visual inspection prior to final acceptance of the project as required by the specifications.

2. Bedding and backfill of sewers. The importance of the proper bedding and backfilling of sewers cannot be over emphasized. The City has updated its standard specifications such that all storm sewer pipe will be installed on an improved bedding.

3. Protection against corrosion of steel pipe by means of sand or gravel encasement. The change in bedding and backfill specifications recently made by the City, does not go far enough to provide the encasement around the

corrugated steel storm sewer the Task Force feels is necessary to afford protection in corrosive soils. The designer should note, however, that as the City standard bedding requirements are now written, a load factor of 1.5 is provided. Special site conditions dictate variations in construction methods. The designer is responsible for specifing a higher class bedding or specifying a stronger conduit in situations where the standard specifications are not adequate to cover a special condition on a project.

4. A deflection limit on flexible pipe. Flexible conduits depend on deflection of the pipe to transfer loads on the pipe to the passive soil resistance of the backfill. Technical literature indicates that long term deflection may exceed initial deflection by as much as 24 to 50 percent. This continued deflection will lead to pipe failure and can, in most cases, be attributable to excessive deflection existing when the project was completed. With this in mind, it would seem appropriate to establish a limit for initial deflection. Technical literature concerning flexible conduits seem to uniformly recommend an initial deflection limit of five percent.

5. Compaction method for flexible pipe. The use of jetting or flushing for compaction in the installation of flexible pipe seems in the least to be a risky procedure, because it is most difficult to obtain equal compaction around the pipe. Where proper compaction is so vital to the structural integrity of the flexible pipe installation, it should be done with suitable material in layers, using hand and mechanical tampers.

VI MAINTENANCE

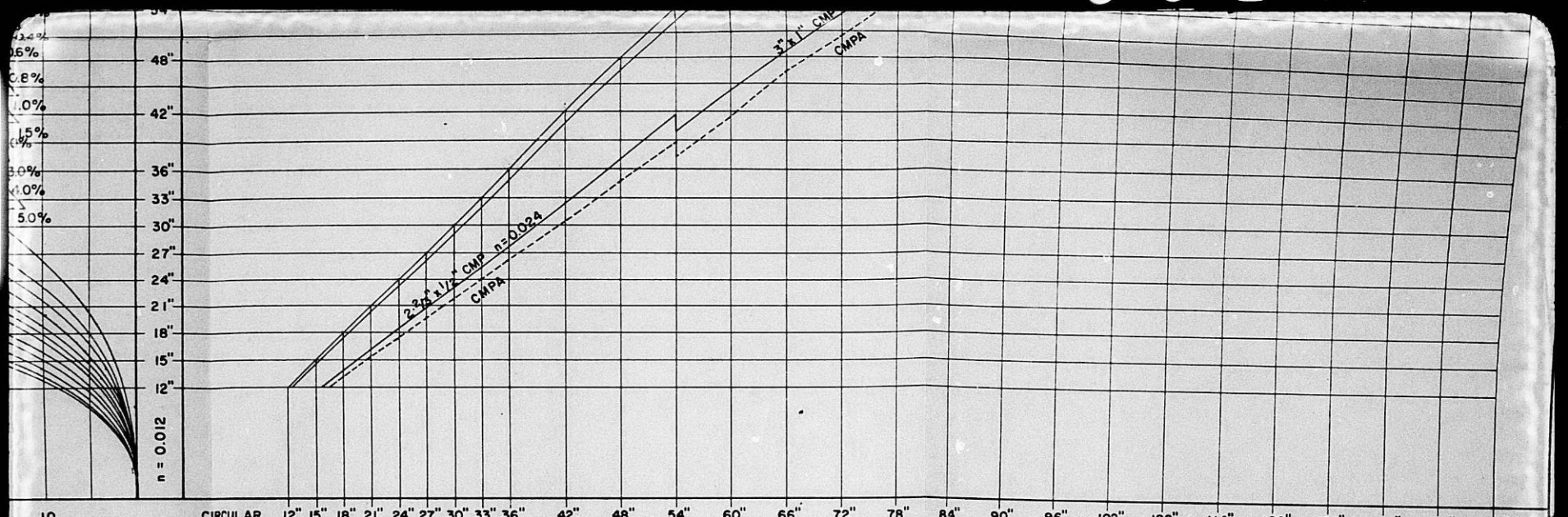
For the years prior to 1972, all City of Wichita storm water sewers were constructed of rigid manufactured pipe made of vitrified clay or Portland Cement concrete or by field assembly of vitrified clay blocks or brick to form rigid arches. There is no record that trunk storm water sewers were periodically inspected to evaluate hydraulic efficiency or condition; to inventory needed repairs or to take measures to preserve or extend service life of the sewer. Even as the Sewer Maintenance Division began to implement its preventive maintenance program for sanitary sewers in the late 1950s and early 1960s, the work program for storm water sewers consisted almost entirely of tasks aimed at reducing the time water was impounded on streets or private property. These tasks were "letting water down" (removing obstructions at inlet openings), unblocking small diameter collector pipes (usually at catch basin outlets), cleaning catch basins, repair of curbs and/or catch basin castings at inlets, replacing catch basin lids and miscellaneous repair to pipes damaged by various types of construction work.

Although there probably were instances where the condition of the trunk storm water sewer contributed to a significant loss of design capacity, there was no post-construction monitoring program to measure flow rates during storms and compare them with design flow rates. Where chronic ponding problems persisted past "letting down", catch basin cleaning, or lead pipe opening, they were generally attributed to "over-taxed" trunk lines. Only rarely did the problem turn out to be a failure of the pipe or arch materials.

In spite of the apparent shortcomings of this policy of benign neglect, it worked--not so much because of the policy, but because of the materials. As a practical matter, once in place the storm water sewers of ceramic or reinforced concrete were not subject to loss of hydraulic efficiency, change in cross section, or deterioration of surface. Recent inspections show no significant difference between concrete pipe storm sewers installed as long as 50 years ago and those installed recently.

City records show that one of the first concrete pipe storm water sewers in Wichita was laid in an alley (still unpaved) west of Laura between Harry and Osie, and in Laura from Osie to Funston. Installed in 1930, this line is still in service and was recently inspected with a television camera. Although the City began to log its cleaning activities in 1965, there is no record that this line has ever been cleaned. The TV inspection showed the presence of "hairline" cracks. These cracks were determined not be an indication of structural failure and showed no adverse effect on the operation of the sewer. The general condition of this line is good.

Beginning in 1972 or 1973, corrugated steel pipe was installed in City of Wichita storm water sewers and at least 40 projects totaling 60,247 linear feet of pipe of various sizes have been booked on City records to date. Records of the Sewer Maintenance Division of the Water Department show that no changes have been made in storm water sewer maintenance policy and that steel pipe has been neglected as benignly as concrete pipe has in the past. Inspections made recently, and 30 years of experience with coated steel culverts on the Wichita-Valley Center Flood Control Project, indicates that, at least with respect to the bituminous coatings and pavings, neglect will not work.



CIRCULAR	12"	15"	18"	21"	24"	27"	30"	33"	36"	42"	48"	54"	60"	66"	72"	78"	84"	90"	96"	102"	108"	114"	120"	126"	132"	138"	144"
ELLIPTICAL			23/14		30/19		38/24		45/29	53/34	60/36	68/43	76/48	83/53	91/58	98/63	106/68	113/72	121/77	128/82	136/87	143/92	151/97	158/102	166/106	174/110	180/116
ARCH (NOMINAL)			22/13		29/18		36/22		43/27	50/31	58/36	65/40	72/44	73/55	81/59	87/63	95/67	103/71	112/75	117/79	128/83	137/87	142/91	150/95	154/100	167/103	171/107

STORM CONDUIT SIZING CHART

MANNING FORMULA

$$Q = \frac{1.486 \cdot A \cdot R^{2/3} \cdot s^{1/2}}{n}$$

FLOWING FULL CONDITION where:

- Q = FLOW (Cubic Feet per Second)
- A = AREA (Square Feet)
- R = HYDRAULIC RADIUS (Feet)
- s = SLOPE (Feet per Feet)
- n = FRICTION FACTOR (Manning)

DR82-20

Because the Sewer Maintenance Division has less than ten years experience with steel pipe storm water sewers, because the Department of Engineering has no post-construction inspection and evaluation program for steel pipe storm water sewers, and because all, or almost all, literature and reports on use of steel pipe are for culvert installations; the experience with the coated and paved drainage culverts under levees on the Flood Control Project is considered to be the best indication of maintenance requirements for paved steel pipe storm water sewers. All of the steel drainage structures on the Flood Control Project were coated and paved, all were equipped with automatic floodgates on the outfall headwall and they vary in length from 30 to 50 feet. There were 72 culverts on the original Flood Control Project (not including Wichita Drainage Canal) ranging in size from 24-72 inches in diameter.

During one of the early periodic inspections of the Flood Control Project by Corps of Engineer officials, the problem of loss of coating and paving on several culverts, which had been damaged by fire, was reported. Local personnel were instructed to sandblast or airjet clean the metal surfaces and recoat and repave the damaged interior culvert walls with a bituminous material similar to the original coating. Several years later the same procedure was recommended for culverts whose coating and paving were damaged or lost due to chemical reaction.

Although the practices described above appeared to be effective at the time, the new coatings and pavings have not endured and it is difficult to distinguish them from others which have not been recoated. Some of the Flood Control Project culverts have been in service since 1950 and all were installed before 1960. None have been replaced and none are currently scheduled for recoating or repaving.

Inspection of several of the fully paved steel pipe storm water sewers installed in Wichita as early as 1973, and as late as 1981, revealed problems with the paving similar to the problems of the coatings and pavings of the Flood Control culverts. Detached, loosened or badly checked pavings were found at the outlet of all sewers inspected and the pattern of checking or cracking, especially near the bottom, was not limited to the outlet, as was suggested during Task Force meetings. Inspections also found several steel storm water sewers with considerable deposits on the floor of the pipe which prevented appraisal of the condition of a portion of the paving.

On April 23, 1982, the Sewer Maintenance Division attempted to clean three to four inches of deposit from the bottom of 390 feet of 48 inch diameter fully paved storm water sewer prior to making a TV inspection of the line. Most manhole openings in the line are less than 20 inches in diameter making a 15 inch diameter drag bucket complete with side bails the largest equipment that would pass through the manhole openings. As a consequence, the 15 inch drag bucket was able to make only a small opening in the center of the deposit on the floor of the 48 inch pipe. The TV inspection of the line following dragging was not successful because the camera illumination was absorbed by the black pipe interior and it was not possible to obtain sufficient contrast to analyze the video image. Although the TV inspection was not able to detect any damage to the paving, at least one rib of the drag bucket was coated with bitumin following the dragging operation. Some method for the removal of these deposits must be developed if the full design capacity of these sewers is to be restored. Other problems, such as the infiltration of backfill at joints also present unique problems in repairing paved steel storm

sewers. The standard practice to close such joints on concrete pipe is to use a Portland Cement grout but there is no way to bond such grout to the bituminous paving. A list of equipment and techniques used by the Sewer Maintenance Division to open blockages and clean concrete pipe storm water sewers is included in the Appendix. There is concern that many of the listed methods may seriously damage the steel pipe paving and further aggravate the paving repair problem. None of the literature available to the Task Force addressed this concern, except to warn that equipment should be handled with caution to prevent damage to the pipe and its coatings, linings, or pavement.

Use of plain corrugated steel pipe (CSP), in Wichita storm water sewers also began about 1972. A somewhat erratic pattern exists as to the sizes and locations where it was used as an alternate to fully paved steel pipe. Records show that most (18) projects used plain steel pipe for 24 inch diameter and smaller sizes and coated steel pipe for larger diameters although there were six projects which used plain CSP in sizes up to 60 inch diameter. Some earlier plain CSP installations are characterized by open joints and/or bent pipe ends which could catch drag buckets or cable clevises and further bend the pipe ends or even tear sections of the metal.

Experience in maintaining plain CSP has also been limited to culverts, but the number, size and variety of installation has provided a much better base from which to predict the needs of a maintenance program. For instance, the possible damage from fire or common petroleum distillates is greatly diminished and repairs to open or offset joints can be made with the same materials which have been used for years on

ceramic and concrete storm water sewers. A difference in requirements may come from the apparent predisposition of CSP to accumulate a sizable deposit on the pipe floor, and the occurrence, at least at some locations where moisture is present, of rust beneath the deposit. The pipe opening and cleaning practices mentioned earlier, (augering, knifing, creeping, dragging, and high pressure water jetting) are compatible with plain CSP if good field joints are made. Only experience will answer the question of whether or not cleaning production rates on the creeping and high pressure water jetting will be significantly less than for ceramic or concrete pipe because of the reduced hydraulic efficiency (refer to letter from Ace Pipe Cleaning in Appendix).

Another hazard to the operation and maintenance of storm water sewers is utility space conflict and encroachment of lines which are installed by boring or jacking. Storm water sewers are especially vulnerable to encroachment because the trunk lines are of large diameter and present a considerable obstruction to normal utility corridors, while the lead pipes connecting inlets to mains are often difficult to identify from the surface. With more and more utility services being installed by either boring or jacking, these encroachments go unnoticed until the storm water becomes blocked or the backfill failure reaches the surface. In most instances the small diameter utility line punches a two to three-inch diameter hole in the rigid pipe sidewalls without doing structural damage to the pipe. After the encroaching utility has been withdrawn the perforations in the rigid pipe sidewall can be grouted, either by hand or with the internal pressure grouting system owned by the Sewer Maintenance Division. There is reason to believe that an encroachment may, over time, cause major deformation of the sidewall of CSP. Eventually, after loss of backfill

through the encroachment rupture, the pipe could collapse. In any event the jagged metal at the encroachment rupture could damage high pressure water hose, video signal cable, firehose, rubber sleeves on internal grouting equipment and pressure grouting hoses.

As part of the research done by the Task Force a 36 inch plain CSP storm water sewer in an area east of Broadway and north of 25th Street North was inspected by television. At one point during the inspection it was discovered that a six inch diameter steel pipe had been driven through the top of the storm water sewer and extended into the sewer a distance of 30-34 inches. This situation apparently happened during the backfilling of the trench. In addition to the steel pipe, there were several deflected areas in the top of the CSP which are assumed to also have occurred during backfilling. Repair of the CSP at the point of the encroachment by the 6-inch steel pipe was made by excavating to expose the sewer, cutting the punctured section of CSP from the sewer and covering it with sheet metal.

VII APPENDIX

A. Recommended Manning's Friction Factors

B. Equivalency

1. Equivalent Capacity Graph (2-2/3"x 1-1/2")
2. Equivalent Capacity Graph (3"x 1")

C. Storm Conduit Sizing Chart

D. Recommended Gauges for Corrugated Steel Pipe

E. Photographs and Description of Sewer Cleaning Equipment

F. Letter From Ace Pipe Cleaning, Incorporated

G. Minimum Velocity - 2fps @ 20 Percent Diameter

RECOMMENDED MANNINGS FRICTION FACTORS

Reinforced Concrete Pipe	
All Sizes	n = 0.013
Corrugated Metal Pipe	
2-2/3" x 1/2" helical and circumferential corrugations	n = 0.024
3" x 1" helical and circumferential corrugations	n = 0.027

PIPE SIZING FOR EQUIVALENT CAPACITY BASED ON MANNINGS EQUATION FOR CIRCULAR PIPES FLOWING FULL

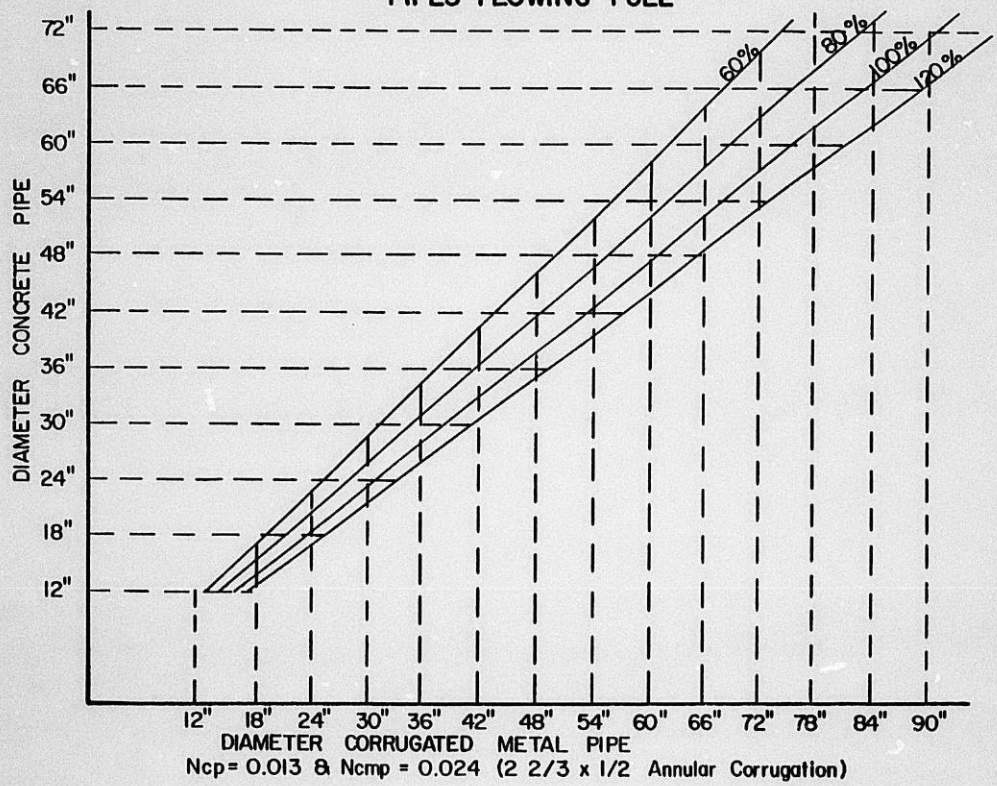
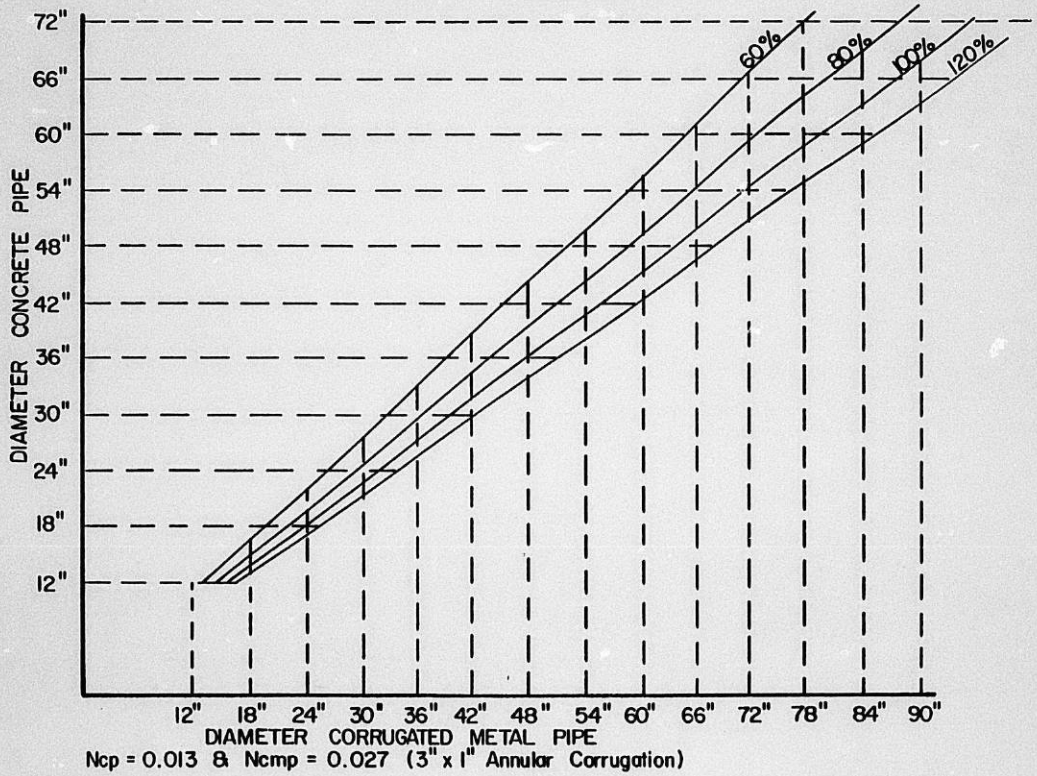


FIGURE 1

VII-2

PIPE SIZING FOR EQUIVALENT CAPACITY BASED ON MANNINGS EQUATION FOR CIRCULAR PIPES FLOWING FULL



Ncp = 0.013 & Ncmp = 0.027 (3" x 1" Annular Corrugation)

FIGURE 2

C. Storm Conduit Sizing Chart

RECOMMENDED GAUGES FOR CORRUGATED STEEL PIPE

Circular Pipe Size in Inches	Arch Pipe Size in Inches	Gauge	Sheet Thickness in Inches
15 (2-2/3" x 1")	17 x 13	12	0.109
18 (2-2/3" x 1")	21 x 15	12	0.109
21 (2-2/3" x 1")	24 x 18	12	0.109
24 (2-2/3" x 1")	28 x 20	12	0.109
30 (2-2/3" x 1")	35 x 24	12	0.109
36 (2-2/3" x 1")	42 x 29	12	0.109
42 (2-2/3" x 1")	49 x 33	12	0.109
48 (2-2/3" x 1")	57 x 38	12	0.109
54 (2-2/3" x 1")	64 x 43	12	0.109
60 (3" x 1")	66 x 51	12	0.109
66 (3" x 1")	73 x 55	12	0.109
72 (3" x 1")	81 x 59	12	0.109
78 (3" x 1")	87 x 63	10	0.138
84 (3" x 1")	95 x 67	10	0.138
90 (3" x 1")	103 x 71	10	0.138
96 (3" x 1")	112 x 75	8	0.168

E. Storm Water Sewer Maintenance Tools, Equipment and Practices

1. Portable, engine driven rod turning machine; steel sectional rods and augers. These tools are used on short sections on small diameter sewers to open blockages caused by roots, limbs, boards, sticks and rocks. A crew of three is usually required for augering.

2. Trailer mounted, engine driven, continuous steel rod rodding machine with springblade root knife, used on small diameter (up to 18") sewers to cut roots. A crew of two is usually required for knifing.

3. Truck mounted water supply tank and PTO driven medium pressure water pump with self propelling (creeper) nozzle used on culverts and short sections of sewer to flush out deposits. The nozzle propels itself and its water supply hose (usually fire hose) into the line and flushes out deposits as it is being manually retrieved. Where available, a fire hydrant can be used to supply water pressure and volume. Crew size depends on method of loading deposits and water supply.

4. High pressure water jet cleaner mounted on vacuum loading truck equipped with water supply tank. The jet cleaner is equipped with as much as 600 feet of small diameter, smooth coated hose which is jet propelled into the sewer; then hydraulically retrieved to flush deposits to the vacuum loading nozzle. The deposits are loaded into a large

capacity hopper mounted on the truck chassis. A crew of two can operate the jet cleaning and vacuum loading operation but a water supply truck is often required.

5. Trailer mounted, engine driven winch and clamshell drag bucket. One winch unit is set at each end of the sewer to be cleaned and the bucket is pulled into the sewer with the clamshell open, then retrieved with the clamshell closed, thereby carrying part of the deposit from the bottom of the sewer to the loading winch where it can be dumped. The clamshell drag is the only tool practical for cleaning sewers larger than 18 to 24 inches in diameter, and they are manufactured in sizes up to 36 inches; however, the largest bucket which can pass through a standard City of Wichita manhole casting is the 15 inch diameter. To use larger buckets, the manhole casting must be removed and part of the manhole stack torn down. The heavy steel clamshell drag buckets ride on skids. Each winch requires an operator and a dump truck is used to haul the deposits away.

6. Mobile closed circuit television inspection and chemical grout repair unit. The van contains the electrical power source to operate the closed circuit television inspection camera, monitor and videotape recorder and to operate the air compressor and multiplex chemical grout pump; chemical tanks; hose reels; winches and other tools.

7. Closed circuit television camera and light source mounted on skids for a 15 inch diameter pipe. The camera is pulled through a sewer pipe by cable winch and sends a video signal to the monitor located inside the van control booth. TV inspection is the only method of determining the condition of small diameter (up to 36") pipe. Photographs of the TV image are used to improve the usability of written logs of TV inspections and when coupled with a videotape recorder can provide a permanent record.

8. TV inspection and chemical grout control booth which contains two-way communications speaker and headphones, TV monitor, videotape recorder, and controls for chemical grouting equipment.

9. Chemical grout pump takes proper amount of chemical from each of two tanks and pushes the chemicals through separate hoses to the grout packer.

10. Chemical grout crack and joint sealing packer in tandem with TV camera. When a cracked pipe or open joint between pipes appears on the TV monitor, the operator can position the packer over the area to be repaired, inflate a sleeve at each end of the packer with compressed air and pump the two-part chemical grout into the cavity. Upon contact, the chemicals combine to form an acrylic plastic seal in the void. The sleeves are deflated, the packer moved away from the grout and the repair is inspected

with the TV camera. Note that in the train connecting the packer-camera tandem are electrical power to camera and light source, compressed air to inflate the packer sleeves and two chemical compounds which must be kept separated until extruded from the packer. Normally a TV inspection-grouting crew consists of a control room operator, rear unit operator and far manhole winch operator.

Ace Pipe Cleaning, Inc.
Specializing in today's needs for environmental protection.
4000 Truman Road • Kansas City, MO 64127 • (816) 241-2891

February 4, 1982

Mr. Irvin L. Penner
547 S. Christine
Wichita, Kansas 67218

Dear Mr. Penner:

In accordance with your request for cleaning various pipes and costs per foot we submit the following:

8 inch thru 21 inch concrete or clay tile sanitary sewers can be light cleaned by power rodding, power brushing or by flushing with the high pressure water jet machine and cost will be approximately $.50 to $.60 per foot.

8 inch thru 21 inch concrete or clay tile storm sewers or combination can be heavy cleaned with the high pressure water jet machine or bucket machine and cost will be approximately $.10 to $.15 per inch diameter.

24 inch thru 96 inch sanitary or storm sewers can be heavy cleaned with the bucket machine, scrappers or vactor units depending on the type of material in the sewers. These lines would have to be looked at before a price can be given.

Corrugated metal pipes are harder to clean and you have to be careful of what you use to clean them so as not to hang and tear holes in the pipe or the tar coating.

An example of cost on the 1,200 feet of 144 inch by 84 inch corrugated metal with 1 foot of material would be 450 cubic yards of material to be removed at approximately $150.00 per cubic yard.

All of the above prices would be with water and disposal site furnished.

If any questions, please feel free to call us.

Very truly yours,

ACE PIPE CLEANING, INC.

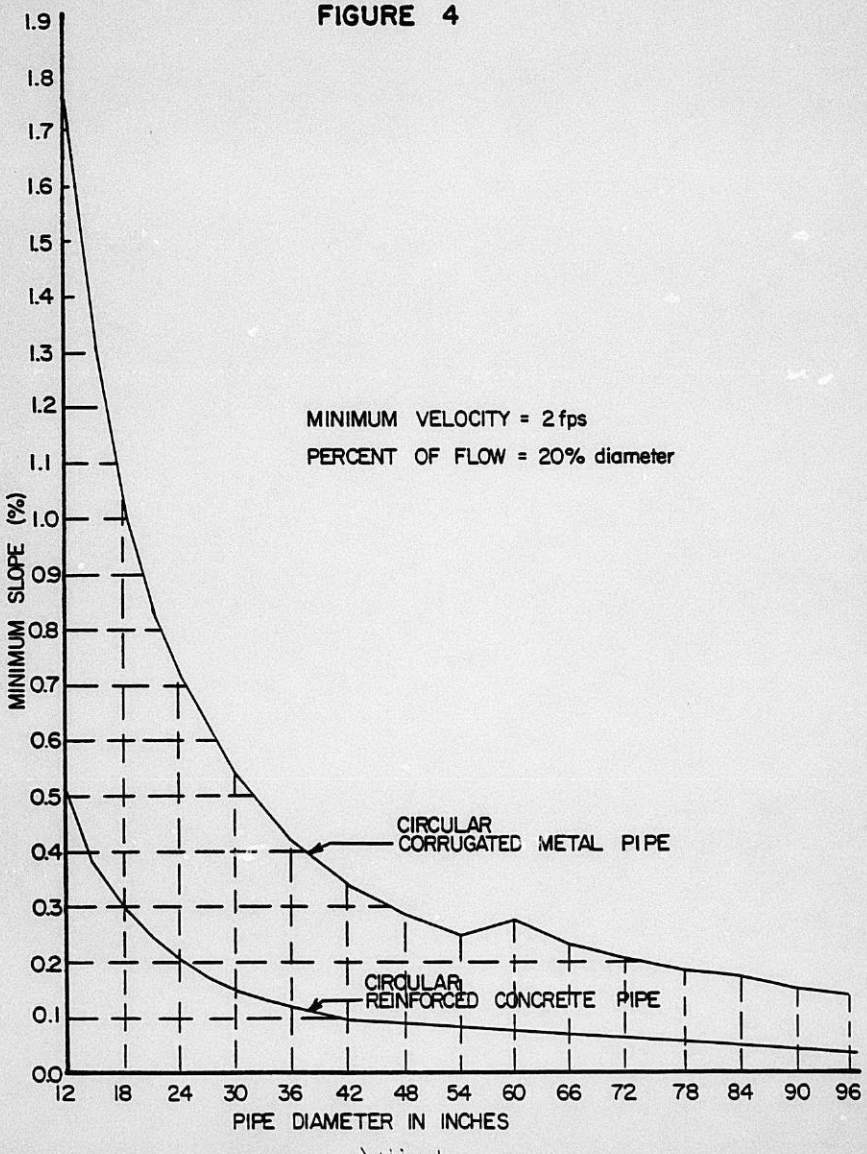
Harold D. Harper
President

HDH:mg:lw

Enclosures

P.S. Also, enclosed you will find our literature on sewer cleaning and a brochure describing the various services we have to offer.

FIGURE 4


MINIMUM VELOCITY = 2 fps
PERCENT OF FLOW = 20% diameter
MINIMUM SLOPE (%)
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
CIRCULAR CORRUGATED METAL PIPE
CIRCULAR REINFORCED CONCRETE PIPE
12 18 24 30 36 42 48 54 60 66 72 78 84 90 96
PIPE DIAMETER IN INCHES