Department of the Interior

Bureau of Reclamation

OPERATION AND MAINTENANCE EQUIPMENT AND PROCEDURES

RELEASE NO. 5

July-August 1953

CONTENTS

INTRODUCTION

This is the fifth Operation and Maintenance Equipment and Procedures Bulletin to be released as a joint effort of the Division of Operation and Maintenance and Division of Design and Construction of the Bureau of Reclamation. We hope we are passing on information that is useful to project operations people. We continue to receive useful suggestions but we need many more for future releases so let's have them. Your suggestions can be mailed to the Bureau's Offices listed below, or the O&M Representative, Design and Construction Division, Building 53, Denver Federal Center, Denver, Colorado.

Regional Director, Boise, Idaho
Supervising Engineer, Sacramento, California
Regional Director, Boulder City, Nevada
Regional Director, Salt Lake City, Utah
Regional Director, Amarillo, Texas
Regional Director, Billings, Montana
Regional Director, Denver, Colorado

Your attention is directed to the memorandum on the subject "Performance of Corrugated Metal Pipe in Turnout Structures" included in this issue of the Bulletin. We believe unbiased consideration of subjects such as the one presented will enable us to reduce costs in the construction and operation of irrigation projects.

Again we repeat that this Bulletin is circulated for the benefit of irrigation project operators. Reference to a trade name does not constitute an endorsement of a particular product and omission of any commercially available item does not imply discrimination against any manufacturer.

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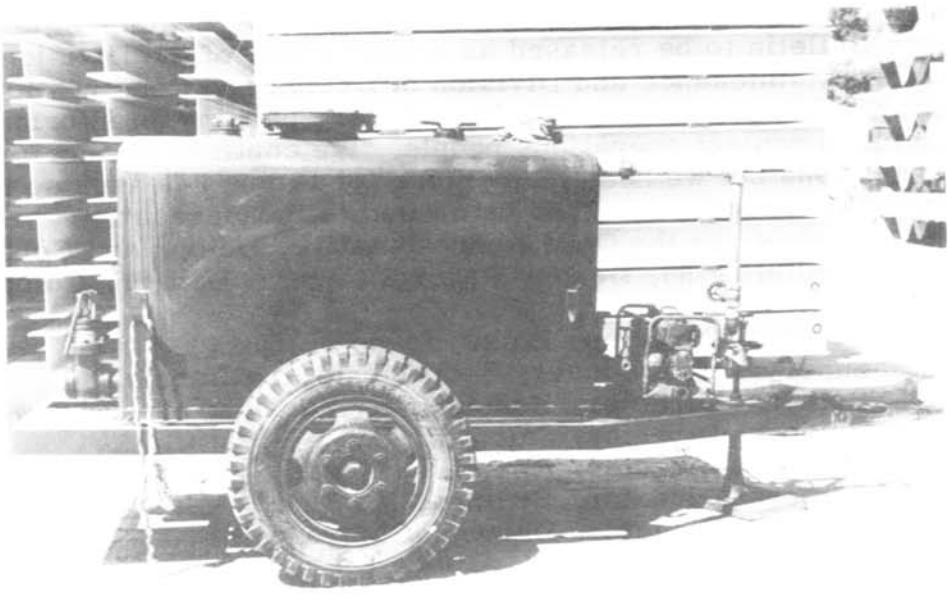
DISPOSAL OF WASTE OILS



The mobile oil spray unit shown above has been developed by the Shasta Division of the Central Valley Project and is used effectively for the disposal of waste oils.

Normally waste oils are disposed of in a dump, but by use of the mobile oil sprayer, 400 gallons of oil may be disposed of at one time. On the Central Valley Project the oil is used along the shoulders of roads for weed and erosion control or in areas where dust may be a problem. The oil tank and gasoline-driven pump are mounted on an ordinary trailer which may be pulled by a pick-up truck. If more detail is desired on the unit contact the Supervising Engineer, California Projects, Sacramento, California.

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BUREAU WATER MEASUREMENT MANUAL

We have been advised that the Bureau's Water Measurement Manual is now available for distribution. The 271-page, pocket-size edition in flexible binding will sell for $1.50. Copies of the Manual for official use can be obtained by requisition. Others may obtain copies of the Manual from the Property Management Section, Bureau of Reclamation, Denver Federal Center, Denver, Colorado.

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THE ATHEY HILOADER

A commercially available piece of equipment, the 125 Athey HiLoader, in conjunction with a motor patrol grader, has been used to good advantage by the Taussig Brothers in the cleaning and enlarging of ditches on their Bethel Hereford Ranch, near Parshall, Colorado. The HiLoader has proved to be an efficient earthmoving tool for this type of work, making a clean 8-foot pick-up of the material in one pass and loading the loose or lightly compacted material involved. The 13- to 18-foot hydraulically controlled swivel discharge conveyor will cast material to either bank of the ditch without changing direction of the machine. High road speeds of the machine, up to 20 mph, provide for rapid movement from job to job.

The Taussig Ranch is located on the western slope of the Continental Divide in Colorado, in sagebrush country where good irrigation of pasture land is a "must" for efficient cattle raising. Every season the ditches are cleaned to assure an adequate flow of water to the far reaches of the irrigation system. This past year some of the ditches were enlarged from an 8-foot to an 11-foot bottom width.

In the fall season, irrigation is discontinued and the ditches dry out. The subgrade, after the ditches have dried, is firm, the soil being light and sandy with practically no rock. With one pass, the loader's 8-foot width of gather is sufficient to clean all material, even

from an 11-foot bottom width ditch, if it is first windrowed with a motor patrol. However, by making two passes with the loader in the 11-foot ditches, there will be no need for the motor patrol unless side-slopes are to be trimmed.

Typical views of the work accomplished are shown in the accompanying photographs. The Taussigs are convinced that the new loader will pay for itself within a relatively short time, since costs of hiring contractors to clean the ditches with bulldozers, as was previously done, was slow and costly. In widening the ditches, the loader and motor patrol completed about 5 miles of ditch per day.

The 125 Athey HiLoader is manufactured by the Athey Products Corporation, 5631 West 65th Street, Chicago 38, Illinois.

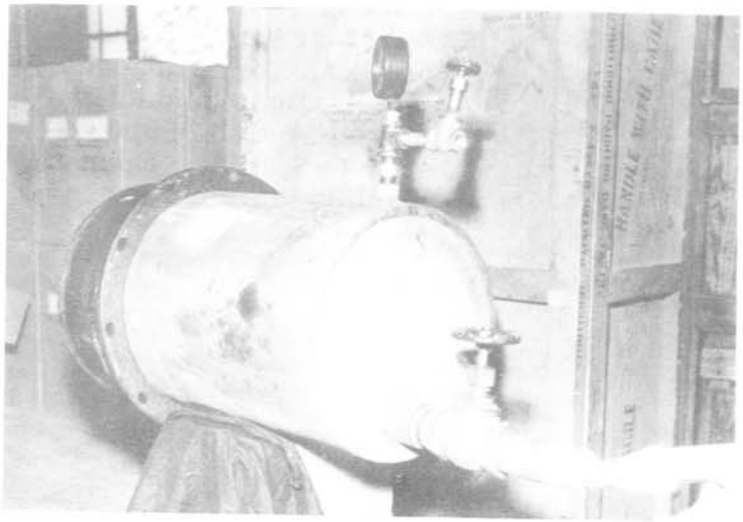
* * * * *

TESTING PIPE

If you have much pipe to test, the testing of it may be accomplished very easily by the use of the device shown below and developed by the Shasta Division of the Central Valley Project. Pipe of 4- to

16-inch in size has been tested with the device shown below, eliminating the necessity of handling large sections of pipe and valves. The equipment necessary can be handled and installed by one man and the testing is accomplished with complete control in venting the line, introducing test water, applying the desired pressure and draining.

The device is attached to the downstream end of the pipe or pipe line to be tested. An air vent at the top of the device may be utilized for pressure gage readings if desired. While filling the pipe line, the air vent is left open until all air has been forced out of the line. Pressure may be applied through the test head section without interference to the pressure gage by using the valve at the closed end of the testing head.



The device consists of a two-foot section of pipe, the same diameter as the pipe or line to be tested. A gate valve is located on the closed end, with the air vent on top. When attaching the device to the pipe to be tested, a dresser-type coupling slides over the outside end to a dresser-type line. A dresser-type coupling using a short flanged section can be used for a flanged line. In like manner the same flanged section with a screwed connection on the inside may be used for screw-type pipe lines.

Much time and effort has been saved by use of the device on the Central Valley Project.

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WHEELED TRACTORS PULLING SMALL SCRAPERS AID IN O&M WORK

Wheeled tractors pulling 5-cubic yard scrapers are used to good advantage on the Columbia Basin Project in O&M operations.

The photographs to the left show the units at work on the East Low Canal bringing in earth material to be used as compacted earth lining.

The project considers the equipment to be a valuable addition to their O&M equipment pool. The units are small enough to be maneuverable. Yet, they are still of sufficient capacity to move a lot of material in a short time. On the road they can be moved from place to place in a hurry.

The tractors, are utilized as motive power for other work on the project. For additional information, contact the Irrigation O&M Supervisor, U.S.B.R., Ephrata, Washington.

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MARKING IRRIGATION STRUCTURES WITH DATE OF CONSTRUCTION

Upon inspecting a structure for the purpose of determining the performance of construction materials, the first step is to appraise the condition of the structure. The second step is to determine the length of time the structure has been in service. For this reason the dating of

all structures is highly desirable, and is a procedure recommended by Region 5, Bureau of Reclamation, Amarillo, Texas.

It has been the practice of the Bureau of Reclamation to mark all major structures with the date of construction. On power plants, pumping plants, tunnels, large siphons, and other major works, this is a requirement of the Reclamation Manual. The smaller irrigation structures are not usually marked and it has not been required, although it is suggested in the Bureau Concrete Manual, 5th Edition, page 250.

Marking such structures as drops, checks, culverts, smaller siphons, etc., will facilitate determination of the age of a structure during field inspections, aid in making on-the-spot appraisal of material performance, and assist in estimating its probable useful life. The time required to mark the date in the fresh concrete of unformed surfaces is insignificant. In formed surfaces, inexpensive expendable sheet metal or plastic figures nailed to the inside surface of the wood formwork can be used. Such a procedure is being done on many Water User and Bureau operated projects.

* * * * *

OFF-SEASON PROTECTION OF UNDERGROUND WORKS

Weed racks placed at the ends of siphon structures prevent the entrance of trash, tumbleweeds, and animals during the non-operating season on the Cambridge Canal of the Frenchman-Cambridge Unit of the Missouri River Basin Project in Nebraska. The lightweight racks, similar to the one shown in the photographs to the left, are placed in the fall after the irrigation season and removed the following spring before water is again placed in the canal system.

The lightweight racks consist of pipe, steel rail or wooden frames, to which a wire mesh is attached. They have been very effective and are believed to have reduced O&M costs materially.

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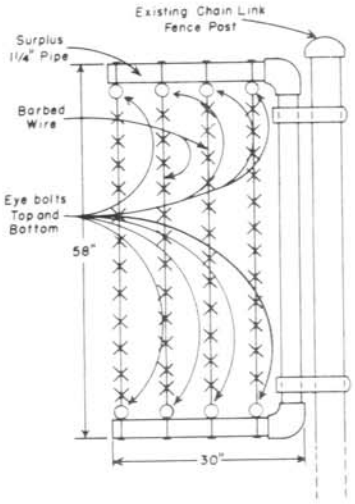
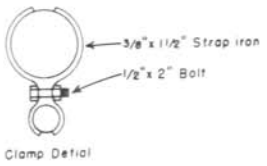
SAFETY FENCE EXTENSION PROTECTS UNDERGROUND WORKS

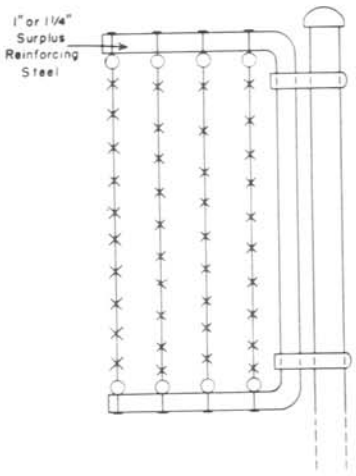
An inexpensive, wing-type extension is being placed on safety fences at the entrance to siphons and other underground works on the Friant-Kern Canal of the Central Valley Project, California. The extension has been found necessary to prevent the adventuresome from gaining access to the top of the concrete transition inside the originally installed safety fence.

An installation at a siphon is shown in the photograph to the left. The extension shown is fabricated from 1-1/4-inch pipe. Fabricated either from pipe or concrete reinforcing steel, as shown in the drawings below, the extension can be installed in a few minutes using the strap-iron clamps.

To prevent the extension wing from being swung out of position, it is braced to the nearest fence post at the top or bottom.







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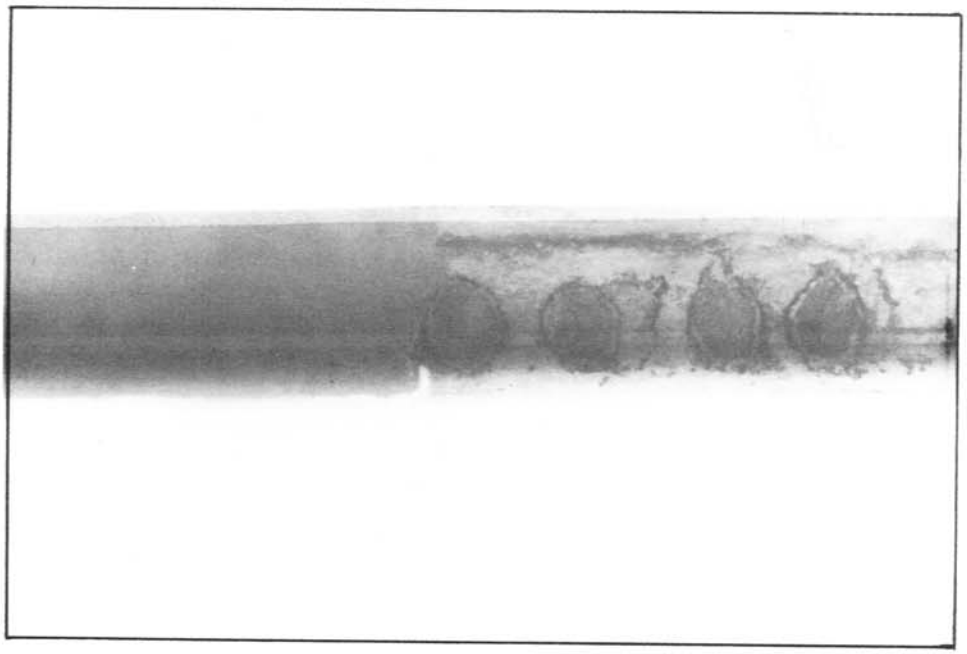
DISCOURAGING SWALLOWS FROM NESTING

The annual flight of swallows to the power features in the Shasta Dam Division of the Central Valley Project has caused considerable concern, especially the unsightly nests and droppings.

In order to discourage the swallows from building their nests in the more prominent locations, vertical walls and surfaces to which the mud nests are attached are treated with a paint filler followed by the application of an enamel paint. All holes, cracks and rough surfaces are filled. Eliminating the footing which swallows must have while building their nests, eliminates the swallows.

In the photograph below, a light gray enamel paint has been used to paint the concrete wall without too much difference in contrast with respect to the natural concrete color. Control of the nesting of swallows by the painting method is new in the Shasta Dam Division and for this reason it is difficult to evaluate the benefits. However, it is estimated that the cleaning of transformer bushings, insulator supports and the general cleaning of other equipment in the immediate area following the annual flight of the swallows will decrease O&M costs by approximately 200 man-hours annually.



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AN IMPACT WRENCH SAVES TIME

Actually a small tool, but one with which much time can be saved, is the impact wrench. Pneumatic impact wrenches used on the Shasta Division of the Central Valley Project have been estimated to have saved about 60 percent of the time normally required in tightening screws and nuts during the period of one year.

Another recommendation for the wrench is that it is possible to obtain approximately even tension over a given area. The workman shown in the photograph to the left is using the impact wrench with a screw driver attachment for tightening screws in a gate seal.

Most of the smaller pneumatic wrenches of the size shown can be operated with the air supply found in most garages and project shops. A pressure of about 80 to 90 psi is needed and the volume required is not large. Impact wrenches powered by electricity are also available.

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PERFORMANCE OF CORRUGATED METAL PIPE IN TURNOUT STRUCTURES

In order to better evaluate the performance of corrugated metal pipe in service on our projects under varying conditions, certain field offices of the Bureau of Reclamation were asked to report upon the condition of the pipe installations known to exist in their areas. Results of the inventory are believed of sufficient interest to all irrigation projects that inclusion of a memorandum on the subject in this release is worth-while. The memorandum follows.

Denver, Colorado
June 3, 1953

Memorandum

To: Chief Engineer

From: S. T. Larsen

Subject: Performance of corrugated metal pipe in turnout structures

Since some of our field offices have requested permission to use corrugated metal pipe in turnout structures, in certain instances, the question has arisen as to the desirability and serviceability of such installations. In years gone by, the use of corrugated metal pipe turnouts was not at all unusual in the Bureau, but more recently we have been specifying precast concrete pipe or monolithic concrete boxes almost exclusively. The reason for favoring concrete has probably been that it was considered to be more durable, since there does not seem to be much difference in cost at the point of production. If a long haul is necessary, the freight charges on the concrete pipe would soon result in a difference in cost.

While under certain conditions, precast concrete pipe might last longer than corrugated metal pipe, the hazards of frost action, alkaline soils, and other dangers tend to minimize this advantage. On the other hand, the relatively light weight of the corrugated metal pipe makes it easy to handle and install; and there are few, if any, joints in the average turnout line made of CMP, all of which should result in lower installation costs.

In order to better evaluate the performance of the corrugated metal pipe in service under varying conditions, certain field offices were asked to report upon the condition of corrugated metal pipe installations known to exist in their areas. Excellent cooperation was had from all but one office, a regional office, which regretted that they lacked funds to furnish the information requested. The Shoshone Project submitted sample coupons cut from a CMP turnout pipe installed originally in 1925 and recently moved because of a change in alinement of the canal. They also sent a sample of the soil surrounding the pipe, so that it could be tested for corrosivity. This was done in our laboratory where a spectroscopic analysis of the metal was also run to determine the type of steel used.

To assist us in obtaining information on the numerous corrugated metal pipe turnout structures in use in the irrigated areas near Denver, the services of Mr. Max Newell and his Assistant, Mr. Louis Parkinson, were offered by Armco Drainage and Metal Products, Incorporated. They took D. G. Tabler, of the Canals Branch, and myself on a 2-day tour of installations north of Denver and in the Colorado Springs area, showing us structures operating under varying degress of severity exposure and having been in service for varying periods of time. Of the corrugated metal pipes inspected, some were plain galvanized; some were galvanized and dipped; and others were asbestos bonded and dipped. Mr. Newell also was able to tell us the age of each structure or brought us in contact with people who could.

From the information received from the field and from the observations we made, a number of conclusions were drawn. These are:

a. The two principal factors affecting the life of a corrugated metal pipe turnout probably are: The amount of abrasive materials carried by the water, and the amount of water passing through the pipe annually.

b. The ability of asbestos-bonded metal to resist abrasion is very much greater than is that of plain galvanized metal.

c. For the difference in cost between plain-galvanized corrugated metal pipe and asbestos-bonded corrugated metal pipe, the much longer life of the latter fully justifies the additional cost, which is only about 20 percent.

d. As a rule, the bank material surrounding the outside of a CMP turnout structure is relatively dry so the effects of corrosive salts in the earth are not so evident as they would be in a drain structure, for instance. This is shown in the case of the Shoshone structure when the surrounding earth is classed as being "severely corrosive," but the galvanizing on the outside of the pipe is still in very good condition after 28 years of exposure.

e. While the two pipes observed which had really failed were not in turnout structures, they did serve to show what could be expected under extreme conditions. These pipes lay, one for about 25 years and the other for 16 years, in a very corrosive saturated soil.

f. The resistance of corrugated metal pipe to corrosive action, as compared to the resistance of precast concrete pipe to the same influences, is probably not too important when we are considering turnout structures, since both concrete and steel are vulnerable to alkali salts, and it appears that other factors are more influential in determining the life of a pipe turnout structure.

g. In comparing precast concrete pipe and corrugated metal pipe for turnouts, the choice between the two should rest upon the evaluation of a number of factors which finally resolve themselves into a matter of long-time annual costs. Following are some of the more important things to consider:

1. Cost of pipe at point of production
2. Cost of transportation
3. Cost of installation, ease of handling
4. Occurrence of joints in the pipe. (Where frost heaving or foundation settlement occurs, precast pipe lines generally break at the first joint downstream from the headwall. Joints also are likely to cause leakage which, in turn, soaks up the bank and, if alkali salts are present, encourages deterioration.)

5. Roughness coefficient of the pipe. (Where allowable head loss is a critical consideration, the less favorable flow condition in a CMP might be a determining factor.)

In view of the various considerations expressed above, the following recommendations are made:

a. Since corrugated metal pipes have given very good service in turnout structures, both on Bureau-built projects and on private systems, and since there are certain advantages to be enjoyed from their use, full consideration should be given to using corrugated metal pipes in farm turnouts from laterals in the future.

b. Since the patents governing the asbestos-bonding process are expected to expire within a few years, the designers should be alert to that situation; and, if asbestos-bonded steel becomes available from competing suppliers, thus removing present procurement difficulties, they should take advantage of the superior performance offered by this material.

S. T. Larsen

I concur:

D. E. Tables

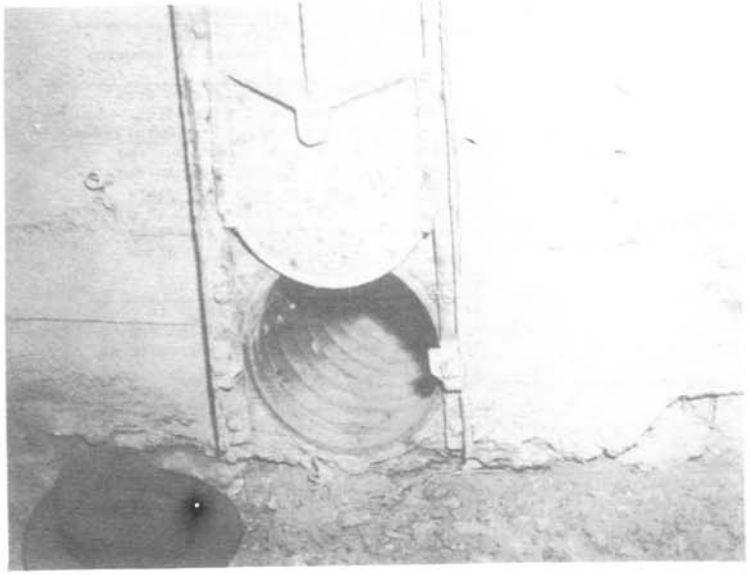
Copies in duplicate to: Commissioner, Attention: 200 and 400
Regional Director, Boise, Idaho, Attn: 1-200 & 1-400
Regional Director, Sacramento, Calif., Attn: 2-200 and 2-400
Regional Director, Boulder City, Nevada, Attn: 3-200 and 3-400
Regional Director, Salt Lake City, Utah, Attn: 4-200 and 4-400
Regional Director, Amarillo, Texas, Attn: 5-200 and 5-400
Regional Director, Billings, Montana, Attn: 6-200 and 6-400
Regional Director, Denver, Colorado, Attn: 7-200 and 7-400

APPROVED: JUN 8 1953
(date)

L. N. McClellan
Chief Engineer

PERFORMANCE OF CORRUGATED METAL PIPE TURNOUTS

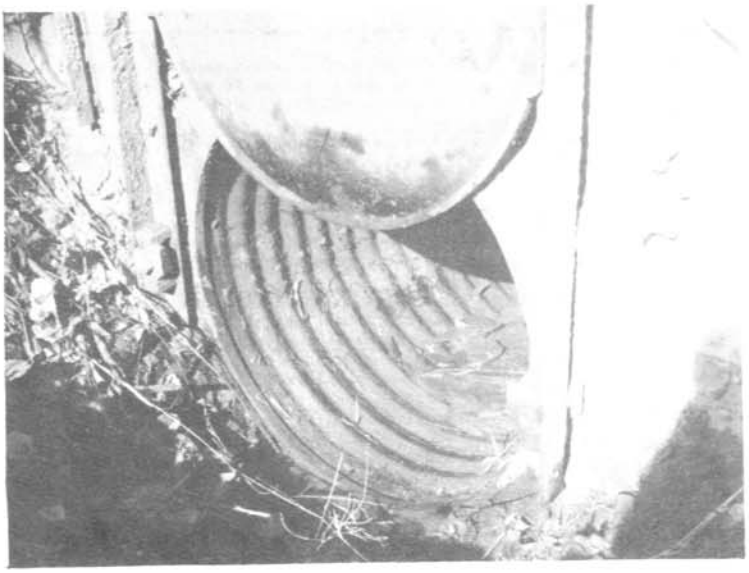
Location of structure	Size of pipe	Years in service	Degree of exposure	Kind of pipe	Condition of pipe--Remarks
Farmers' Ext. of Rough and Ready Ditch(North of Denver) Wetty Turnout	12"	15	Average, some sand:	Asphalt dipped, asbestos bonded, galvanized	Perfect, no damage from erosion. Galvanizing still covered by asbestos bonding
Farmers' Ext. of Rough and Ready Ditch Newman Turnout	30"	15	Average, some sand: in water	Asphalt dipped, asbestos bonded, galvanized	Most of asphalt dipping is gone from invert, but galvanizing is still covered by asbestos bonding.Metal perfect
Farmers' Ext. of Rough and Ready Ditch Newman Turnout	10"	5	Average, some sand: in water	Armco Ingot Iron galvanized only	Base metal is in good shape, but the galvanizing is worn through in the invert. Good for many more years
Farmers' Ext. of Rough and Ready Ditch H. S. Markham Turnout No. 2	12"	15	Average, pipe set 1' + above ditch bottom	Asphalt dipped, asbestos bonded, galvanized	Perfect, most of asphalt still in place. Amount of sand entering pipe less because of being set high in ditch
Farmers' Ext. of Rough and Ready Ditch Clennon Lateral Turnout	36"	15	Average, some sand: in water	Asphalt dipped, asbestos bonded, galvanized	Perfect, most of asphalt still in place. Used with meter gate. Outlet end turned up. Very little corrosion at welds
Sullivan Canal about 50 yrds. east of Highway No. 185, north of Denver	12"	33	Worse than average. Set below ditch bottom	Galvanized only	Most of galvanizing is gone. There is some corrosion, but no deep pitting. Looks like it is good for many years more. Sand in water probably eroded galvanizing
Brantner Ext. Ditch, 2 miles south of Brighton, Colorado	10"	25	Worse than average. Considerable sand	Galvanized only	Most of galvanizing is gone from invert. Metal is not badly corroded or pitted. Good for many years more
Brantner Ext. Ditch, south of Brighton, Kramer Turnout	12"	25	Worse than average. Considerable sand:	Galvanized only	Most of galvanizing is gone from invert. Base metal is not badly corroded or pitted. Good for many years more
Brantner Ext. Ditch, south of Brighton, Muir Turnout	15"	25	Average, set above canal bottom	Galvanized only	Less erosion of galvanizing than two preceding cases because of being set higher above ditch bottom. Takes less sand
Brantner Ext., 1/2 mile north of Denver Poor Farm, Harris Turnout	12"	25	Average, some sand in water	Galvanized only	Most of galvanizing is gone from the invert, but the base metal is OK. Corrosion is not serious. Good for many years more
Fountain Mutual Main Canal, east of Colorado Springs, Colo. Foster Siphon Wasteway	18"	20	Better than average. Not steady operation:	Galvanized only	Galvanizing is gone from the bottom of the invert, but the base metal is not badly corroded or pitted
Fountain Mutual Main Canal, east of Colorado Springs, Foster Turnout	15"	17	Average, some sand: in water	Galvanized only	Galvanizing is mostly gone from lower 1/4 of pipe. Rest of galvanizing OK. Base metal is in good condition
Fountain Mutual Main Canal, east of Colorado Springs, West Foster Turnout	15"	20	Average, some sand: in water	Galvanized only	Galvanizing is gone from the invert, but the base metal is good, not badly corroded. Good for many more years
Fountain Mutual Main Canal, east of Colorado Springs, Vorhees Turnout	12"	14	Better than average, not used steady	Galvanized only	The galvanizing is intact in spite of the water-carrying average amounts of sand; however, the amount of water passing through this pipe averages 10 A.F./year
Fountain Mutual Main Canal, east of Colorado Springs, Thomas and Farmer Turnout	12"	30	Average, some sand: in water	Galvanized only	Most of galvanizing is gone from invert of pipe, but base metal is sound and not badly corroded. Good for many more yrs.
Fountain Mutual Diversion Canal Desilting Pipes	18"	10	Very severe; heavy bed load,corrossive water,constant operation	Galvanized with paved invert	That part of the pipe overhanging the outlet headwall has been eroded through the paving and the pipe itself by the heavy load of sand and gravel removed from the canal by this installation. This structure operates continuously throughout the year
Shoshone Project,Willwood Division, Willwood Canal, Sta. 821+30,Farm Turnout	18"	28	Soil around: pipe is corrosive: other conditions average	Pure iron-type metal galvanized: inside and outside plus asphalt coating on: inside	Galvanizing on outside of pipe is in excellent condition, largely intact.Much of interior asphalt coating still in place; some damage to galvanizing;base metal OK; corrosion of base metal not bad
Fountain Mutual Irrigation District Dam, east of Colorado Springs. Outlet for toe drains	12"	25+	Soil around: pipe very: corrosive; high in salts, swampy	Pure iron-type metal galvanized, dipped,perforated:	Dam is founded on shales high in salts. Dam operated over 20 years before toe drain was installed. Area below dam was swampy and very high in salts. Perforations probably speeded up corrosion processes. Pipe was completely eaten up and had been replaced
Fountain Mutual Irrigation District-Souers Equalizing Reservoir. Outlet works	18"	16	Extremely severe. Pipe set in shale which is high in alkali salts and: is wet most of time	Galvanized only	Upper end of pipe has been eaten through so that it must be replaced. Asbestos-bonded pipe will probably be used for replacement. Gate and guides are also badly corroded



Rough and Ready Ditch
Photo No. 1 Farmers' Extension

Wetty Turnout, 12" diam. asphalt dipped asbestos bonded CMP. In excellent condition after 15 years of service under average conditions.

Photo taken 2/16/53



Rough and Ready Ditch
Photo No. 2 Farmers' Extension

Newman turnout, 30" asphalt dipped asbestos bonded CMP. After 15 years of service the asbestos bonding is still intact protecting the galvanizing and base metal. There is some sand carried in the water and other conditions are about average.

Photo taken 2/16/53

Rough and Ready Ditch
Photo No. 3 Farmers' Extension

General view of Newman turnout showing pipes depicted in Photos Nos. 2 and 4.

Photo taken 2/16/53

Rough and Ready Ditch
Photo No. 4 Farmers' Extension

10" glavanized Ingot Iron CMP installed at Newman turnout. Much of the galvanizing is gone from the invert of the pipe and there is a little corrosion of the base metal so the pipe should be good for many more years service. The advantages of asbestos bonding are readily apparent by comparing this pipe with that shown in Photo No. 2.

Photo taken 2/16/53

Rough and Ready Ditch
Photo No. 5 Farmers' Extension

Metergate turnout to Clennon Lateral, inside of 36" asbestos bonded, asphalt dipped, CMP. Welds to form elbow show little corrosion and what there is does not appear to be spreading badly. This pipe has been in service about 15 years.

Photo taken 2/16/53

Rough and Ready Ditch
Photo No. 6 Farmers' Extension

View of downstream portion of structure shown in Photo No. 5. Metergate wells are of plain galvanized steel and are badly pitted after 15 years of service while the asbestos bonded pipe is in perfect condition.

Photo taken 2/16/53

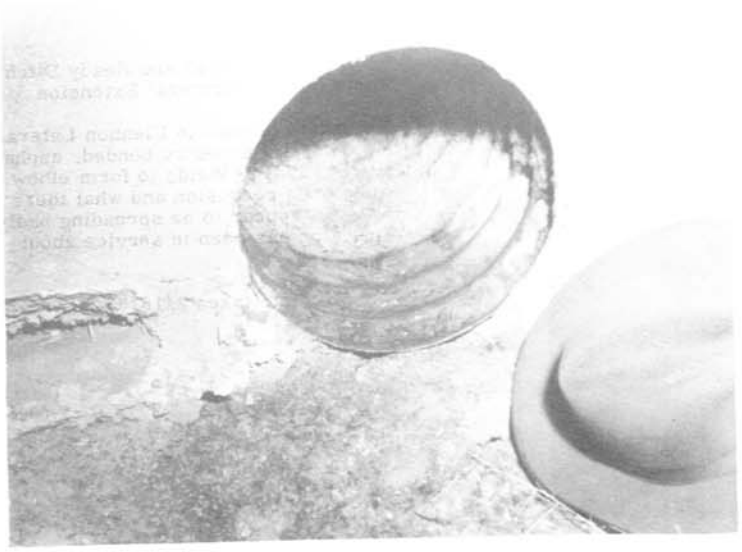


Photo No. 7 Sullivan Canal

12" galvanized CMP turnout about 50 yds. east of Hwy. 185 north of Denver. This pipe has been in service about 33 years and while most of the galvanizing is gone from the inside of the pipe, the base metal is not too badly corroded and will likely serve for many more years.

Photo taken 2/16/53

Photo No. 8 Brantner Extension Ditch

15" galvanized CMP turnout to Muir place south of Brighton, Colorado. While much of the galvanizing is gone from the invert the pipe is still in good shape after 25 years of service. The base metal is not badly corroded. This pipe was set with the invert about a foot above the bottom of the canal which probably permitted the entry of less of the bed load of sand and gravel.

Photo taken 2/16/53

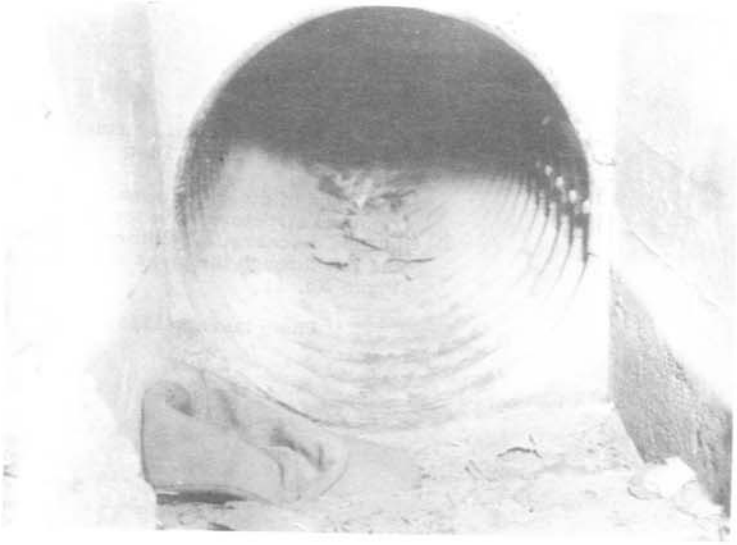


Photo No. 9 Fountain Mutual Irrig. Dist.

15" galvanized CMP turnout (West Foster Turnout), the outlet end. Sand carried by the water has eroded the galvanizing out of the invert but the base metal is sound and the pipe is good for a lot more service. It has been in service for 20 years.

Photo taken 2/17/53

Photo No. 10 Fountain Mutual Irrig. Dist.

12" galvanized CMP turnout to Thomas and Farmer places. This structure carries about 110 acre feet of water annually with considerable sand in it. It has served for 30 years and, while the galvanizing is gone from the invert, the base metal is still sound and good for a long time more.

Photo taken 2/17/53

Fountain Mutual
Photo No. 11 Irrig. Dist.

Two 18" galvanized paved invert CMP's serving to discharge the sand and gravel removed from the diversion canal in the middle background. The left pipe gets the heaviest load of sediment since it is upstream. The paved invert and the pipe itself are worn completely through at the outlet end. It has served about 10 years during which time it has run continuously throughout the years.

Photo taken 2/17/53

Fountain Mutual
Photo No. 12 Irrig. Dist.

Head end of diversion canal. Sand removal structure is in the foreground discharging sediment towards the left through the pipes shown in Photo No. 11.

Photo taken 2/17/53

Fountain Mutual
Photo No. 13 Irrig. Dist.

Remains of 12" galvanized dipped (not asbestos bonded) perforated CMP used to outlet toe drains from Fountain Mutual Irrigation District dam east of Colorado Springs. The dam was built in 1901 but the toe drains were not installed until about 25 years later when high concentrations of salts had built up in the area just below the dam. The pipe in the picture served for about 25 or 26 years before being replaced. The same type of pipe installed at the toe of the dam as pick-up drains is still in service.

Photo taken 2/17/53