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SANITATION MANUAL FOR PUBLIC GROUND WATER SUPPLIES

CONTENTS

Introduction.

This manual has been prepared by the Public Health Service for the guidance of States, municipalities, and health districts in order to encourage a greater uniformity and a higher level of safety in the sanitary control of public ground water supplies.

The Public Health Service, in 1937, appointed a Water Sanitation Advisory Board to consider the formulation of a water supply section as a part of a general sanitation code. This Board at a number of meetings prepared some of the material necessary for a water supply section. In 1940, the Public Health Service undertook to prepare a code on ground water supplies utilizing much of the material formulated by the Sanitation Advisory Board. Several drafts of such a code were referred to the State health officers for review and comment.

Serious objections were voiced to the use of the ordinance and code form and the sentiment in general appeared to be that a manual or guide of recommended practice was preferable. This manual has been prepared with the thought of indicating desirable practice or, more correctly, minimum acceptable standards. The form followed in other Public Health Service manuals has been adopted in this manual, that is: statement of the requirement, the public health reason for the requirement, and what constitutes satisfactory compliance.

The word "shall" has been used throughout the manual to state what must be done to accomplish satisfactory compliance. Because this is a manual or guide, objection may be voiced to this terminology. However, the word "shall" has been used advisedly to permit adoption of the material without extensive editing and revision, if so desired. Where the manual is used as a guide in the preparation of other regulations or is revised to suit the needs of a particular health authority no harm will result from the use of the word "shall" throughout in this manual.

This manual will be subject to periodic review and revision for incorporation of such changes as will increase its usefulness.

SANITATION MANUAL FOR PUBLIC GROUND WATER SUPPLIES

Section 1. Definitions

1. Public water supply. A public water supply is one from which water may be distributed, sold, or made available to the people at large or to any considerable number of members of the public indiscriminately.

2. Public ground water supply. A public ground water supply is a public water supply which obtains water from subsurface sources.

3. Bottled water. Bottled water means any water distributed, sold, or made available to consumers in bottles or other containers.

4. Health officer. Health officer means the health officer of any State, municipality, or district which adopts these requirements, or his duly authorized representative.

5. Person. Person means an individual, a partnership, a public or private corporation, an association, a joint stock company, a trust, or an estate.

6. Cross-connection. Any physical connection whereby the approved supply is connected with any other water supply system whether public or private, either inside or outside of any building or buildings in such manner that a flow of water into the approved water supply is possible either through the manipulation of valves or because of ineffective check or back pressure valves, or because of any other arrangement.

7. Backflow connection. Any system of piping or other arrangement whereby the public water supply is connected directly with a sewer drain, conduit, pool, storage reservoir, or other device which does or may contain sewage or other waste or liquid which would be capable of imparting contamination to the approved water supply

8. Auxiliary intake. Any piping connection or other device whereby water may be secured from a source other than that normally used.

9. Bypass. Any system of piping or other arrangement whereby the water may be diverted around any part or portion of a water purification plant.

Section 2. Registration and Permits

From and after the date of adoption and publication of requirements for public ground water supplies by a State, municipality, or district, no person shall begin construction, alteration, or extension of any public ground water supply without first securing a written permit from the State health officer. Such permit shall be granted

by the State health officer only after examination and approval of detailed plans and specifications which shall have been submitted by said person, or after such survey of the site or installation as the State health officer may deem necessary.

Not later than 6 months after the adoption and publication of requirements for public ground water supplies by a State, municipality, or district, all persons who own or control any public ground water supply shall submit to the health officer a report giving such information relative to said water supply as may be required by the health officer.

Section 3. Inspections

At least once during each 12-month period the health officer shall inspect all public ground water supplies in his jurisdiction for the purpose of ascertaining which supplies shall be termed "Approved Public Ground Water Supplies."

In case the health officer discovers any violation of the requirements which have been adopted, he shall require correction of such violations in writing specifying the corrections to be made and the time allowed for making them. A second inspection shall be made after the lapse of the time allowed for the defects to be remedied and the second inspection shall determine whether or not the supply shall be "approved."

Section 4. Emergency Measures To Prevent Epidemics

Whenever, in the opinion of the health officer, conditions arise in connection with any public ground water supply which warrant emergency measures to prevent a water-borne disease epidemic, said health officer is authorized to apply such measures as he may deem necessary.

Section 5. Approved Public Ground Water Supplies

All "Approved Public Ground Water Supplies" shall conform with the following items of sanitation:

ITEM 1. EXCLUSION OF SURFACE WATER FROM SITE

The site of the source in all directions shall not be subject to flooding and shall be so graded and drained as to facilitate the rapid removal of surface water.

Public health reason.—The exclusion of flood waters from the site and proper drainage of surface water away from the source will help to prevent contaminated surface water from reaching the source directly. If flood waters are excluded for a given horizontal distance, such waters may reach the source only by passage through the soil in the intervening distance, thereby providing a factor of safety against direct pollution.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) Pump platform, pump room floor, or cover of a ground water supply is not less than 2 feet above the highest known high water level of any nearby body of surface water. Where necessary the area should be filled and graded to the necessary height and filling protected from erosion by rip rap.

(2) Flood waters from nearby bodies of surface water are not allowed to approach within less than 50 feet of the source measured horizontally.

(3) The earth surfaces are sloped to drain away from or divert surface water around the spring, infiltration system, well, or pump house, and are so graded and maintained as to prevent the accumulation and retention of surface water within a distance of 50 feet from the source in all directions.

(4) For hillside sites, an adequate intercepting ditch or ditches are constructed around the uphill side of the source in such manner and so maintained as to keep hillside storm water at least 50 feet away from the source in all horizontal directions; the intercepting ditch or ditches may be protected against erosion by rip rap, concrete, or other equivalent ditch lining where necessary.

(5) The source is not located in a ravine where surface water flows may be obstructed or concentrated.

ITEM 2. SATISFACTORY EARTH FORMATIONS ABOVE THE WATER-BEARING STRATUM

The earth formations above the water-bearing stratum shall be of such character and depth as to exclude contamination from the source. If satisfactory sites are not available the water shall be treated by a method or methods approved by the health officer for the specific installation.

Public health reason.—The earth formations above the water-bearing stratum should be of such depth and character as to provide filtration sufficiently adequate to prevent contaminated surface water from reaching the source. Formations such as limestone, broken lava rock, coarse gravel, and brittle rocks whose interstices are in the form of channels, joints, and fissures provide little filtering action to prevent contamination from reaching the water-bearing stratum.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) The earth formations overlying the water-bearing stratum (natural or fill) consist of one or more impervious formations such as clay, silt, stiff clay mixtures, fine sand, or equivalent materials having a combined depth of not less than 10 feet.

(2) The backfill above an infiltration system consists of not less than 10 feet of thoroughly compacted clay, silt, stiff clay mixtures, or equivalent materials.

(3) Treatment approved by the health officer is provided where satisfactory earth formations above the water-bearing stratum cannot be shown to exist. (Treatment may, of course, be required due to other unsatisfactory conditions even though satisfactory earth formations are known to exist).

ITEM 3. DISTANCES TO SOURCES OF CONTAMINATION

Every public ground water supply and all appurtenances thereto shall be located at a safe distance from all sources of contamination such as pit privies, cesspools, septic tanks, subsurface tile systems, sewers, drains, barnyards, and pits below the ground surface.

Public health reason.—The organisms of typhoid fever, dysentery, and other enteric diseases are present in the body wastes of persons sick with these diseases or who are carriers of the diseases. If sources of contamination are located near the water supply source, disease organisms may reach the latter.

Ground waters located in formations such as limestone, broken lava rock, coarse gravel, brittle rocks, or equivalent materials which are not protected against the penetration of contamination by an adequate overlying impervious formation are not suitable for public ground water supplies without treatment.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) The distance from the water supply source to any means of contamination in all horizontal directions is not less than 50 feet. This minimum distance shall be used only where existing conditions indicate it to be sufficient; greater distances should be provided where local conditions indicate the need for greater protection.

(2) In case the area adjacent to the source is accessible to livestock, the site is completely surrounded by a fence located not less than 50 feet from the source in all horizontal directions. Drainage from areas accessible to livestock in the vicinity of water sources is away from the water source.

* * *

MINIMUM DISTANCES TO SOURCES OF CONTAMINATION

Because of the many factors involved in the determination of a "safe distance" from sources of contamination, the following information is given for the guidance of those concerned:

Every ground water supply source such as a well, spring, or infiltration system, and all appurtenances thereto, should be located at a safe distance from any cesspool, privy, septic tank, and tile field, sewer, soil pipe or pipe through which sewage may back up, or from any other possible source of pollution, and in such

manner as to prevent contamination of the water by either underground seepage or channels, or by surface drainage. Coarse gravel, limestone, disintegrated rock, or other porous material which will permit rapid flow of water through it are not suitable materials around a source of supply. When such formations are encountered, more suitable sites should be obtained. If satisfactory sites are not available, adequate treatment of the water should be provided.

The location of ground water supplies on a side hill or at the foot of a hill where cesspools, privies, sewers, or other sources of pollution are situated on the slope above and in the path of the ground water flow and within 300 feet should be avoided.

When a body of ground water tapped by a well is drawn upon, the level of the water in the well will be lowered, and the surface of the ground water adjacent to the well will assume a form similar to an inverted cone. The amount which the water level is lowered decreases rapidly at increasing distances from the well, until at some point, more or less remote, there is no perceptible effect. The area within which the level is lowered appreciably is called the circle of influence.

Where the rate of pumpage from a well exceeds the percolation of water through the water-bearing formation, the water level in the well will drop and the circle of influence will be broadened. For a specific well the draw-down or drop in water level and the diameter of the circle of influence will be much greater usually when pumped at high rates than when pumped at low rates. Because of this fact, ordinary wells which are developed and equipped to provide large volumes of water are more likely to become contaminated from sources of pollution located at greater distances as compared to wells supplying small volumes of water. It is essential, therefore, that the minimum distances between the well and sources of contamination be increased as the rate of pumpage from the well is increased.

* * *

The Minnesota Department of Health has developed a formula for computing approximate safe distances between wells and sources of contamination based on the character of the soil, the capacity of the pump, the permissible velocity through the soil, the slope of the surface or water table, and the length of the screen or depth of flow toward the well. This formula, and tables computed by its application, are presented here:

Let D=Distance between well and the source of contamination, in feet.

P=Pump rate, in gallons per minute.

L=Length of well screen, depth of flow toward well, or thickness of water-bearing formation, in feet.

S=Angle of slope of ground in degrees (approximately parallel to the water table).

K=Coefficient of flow depending on character of soil.

For fine sand:

K=0.11 gallons per square foot per minute.

For medium sand:

K=0.07 gallons per square foot per minute.

For coarse sand and gravel:

K=0.03 gallons per square foot per minute.

When the distance D is such that the limiting velocity K is not exceeded, then the total flow=pump effect plus slope effect.

$$2\pi DLK=P+2\pi DL\ (K \text{ sine } S)$$

Solving for D.

$$D=\frac{P}{2\pi LK\ (1-\text{sine } S)}$$

This formula is not accurate beyond the limits of accuracy of the data used in it. It should not be taken to give definite safe distances, but it has been found useful in checking judgment of distances in the preliminary study of well sites. Careful consideration must always be given to the geological formations on the site especially where there may be faults, ledges, or impermeable dams that interfere with the expected movement of the water.

This formula can be used to develop tables for checking existing installations or decisions regarding new sites. For those who have an aversion to working out a mathematical formula, the table would be helpful. Skeleton tables can be set up and the formula used to fill in any intermediate conditions. To illustrate the working of the formula and table, the following is presented:

Let $P=500$ gallons per minute.
$L=15$.
$K=0.11$.
$S=0$.

$$D=\frac{500}{2\times 3.14\times 15\times .11}=50.$$

For $S=8°$ $D=58$ feet, say 60 feet.
For $S=16°$ $D=68$ feet, say 70 feet.

The formula can be used to determine the approximate safe distance for any combination of screen, pump, soil, and slope with the proviso that no distance shall be less than the 50, 40, and 30 feet that head the 500-gallons-per-minute table. Hand pumps and power pumps of small draft will fall, therefore, under this classification.

TABLE 1.—*Pump capacity 500 g. p. m.—15-foot screen*

Character of soil	Degree of slope	Type of structure containing pollution		
		Cesspools, privies, and clay pipe sewers	Cast-iron pipe, and metal tanks	Sewer connections with extra-cased special joints
		A	B	C
Silt and clay Very fine sand (0.1 mm. and less)	0	50	40	30
	8	60	50	40
	16	70	60	50
Fine sand to Medium sand (0.1 mm. to 0.5 mm.)	0	75	65	55
	8	90	80	70
	16	105	95	85
Coarse sand Fine gravel and well filled mixed gravel (0.5 mm. to 2.0 mm.)	0	175	165	155
	8	200	190	180
	16	240	230	220

TABLE 2.—*Pump capacity 1,000 g. p. m.—15-foot screen*

Character of soil	Degree of slope	Type of structure containing pollution		
		Cesspools, privies, and clay pipe sewers	Cast-iron pipe, and metal tanks	Sewer connections with extra-cased special joints
		A	B	C
Silt and clay Very fine sand (0.1 mm. and less)	0	100	90	80
	8	120	110	100
	16	140	130	120
Fine sand to Medium sand (0.1 mm. to 0.5 mm.)	0	150	140	130
	8	180	170	160
	16	210	200	190
Coarse sand Fine gravel and well filled mixed gravel (0.5 mm. to 2.0 mm.)	0	350	340	330
	8	400	390	380
	16	480	470	460

A—Computed by formula.
B—Arbitrary deduction of 10 feet from A for reducing the possibility of contamination.
C—Deduction of 10 feet from B when amount of contamination escaping into the soil is further limited. Column C represents the minimum distance for any type of construction.

* * *

The two paragraphs following are quoted from "Ground-Water Supplies. Progress Report of the Committee on Ground-Water Supplies Conference of State Sanitary Engineers, 1936" (Supplement No. 124 to the Public Health Reports).

"Toilets, sewers, floor drains, soil pipes, main drains, or other pipes which are connected directly to a storm or sanitary sewer, or through which water or sewage from any source may back up, should not be located nearer than 50 feet, horizontally, to any well, spring, infiltration system, pumping apparatus, suction main, air pipe, air compressor, filter, or other feature of any ground-water supply. In special cases, where it is impossible or not practical to obtain a 50-foot distance, special construction to provide additional safeguards is necessary. In no case shall such fixtures or piping be nearer than 30 feet to a well. All such sewers, drains, and pipes, or parts thereof, which must be more than 30 feet and which are less than 40 feet, horizontally, from any such water supply feature, should be constructed of extra heavy cast-iron pipe with tested watertight leaded joints. In this zone, joints should be further protected against leakage by a substantial slip-over sleeve extending at least 6 inches from each side of the joint. The annular space between the pipe and the sleeve shall be filled with asphalt or material such as sewer-joint compound, or closed with rubber gaskets. All such sewers as lie between 40 and 50 feet of the ground-water supply may be of extra heavy cast-iron pipe with tested watertight leaded joints. Toilets, sewers, soil pipes, or drains should not be located on the first floor directly above the pump-room floor, or where leakage therefrom can reach any source of water supply or pump room.

"Floor drains constructed of cast-iron pipe with leaded joints may be located as close as 2 feet to a ground-water supply, provided they do not connect to a storm or sanitary sewer, and provided they discharge only to the ground surface or to a gravel pocket, which is well removed from contact with sewage or other waste. The cast-iron pipe should be carried to a point at least 4 feet outside the building walls and connected to other suitable pipe which discharges at least 30 feet from the ground-water supply."

ITEM 4. MINIMUM DEPTH OF CASINGS AND CURBINGS

All well and spring basin casings or curbings shall extend a safe distance below the ground surface.

Public health reason.—A watertight casing or curbing which extends a safe distance below the ground surface is essential to insure exclusion of contaminated water from a well.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) The watertight well casing or curbing extends to a minimum depth of not less than 10 feet below the ground surface and preferably 10 feet below the ground water table. The casing should be carried through an impervious stratum above the water-bearing stratum and a tight seal made between this impervious stratum and the well casing to exclude undesirable water strata and surface water. Where such impervious strata may not exist, the well should be grouted throughout its entire depth to seal off all but the water-bearing stratum from which water is to be drawn.

(2) The watertight casing for a driven point well extends the full depth of the well to the water-bearing stratum.

(3) In the case of springs, the water enters the inclosing structure of springs or infiltration systems at points 10 feet below the ground surface. In cases where the 10-foot distance is not obtainable without sealing, cutting off, or diverting the underground source, the springs may be protected by placing earth filling over the area involved (50-foot radius from the spring) to provide the necessary depth of 10 feet of earth over the points of flow. If this is impracticable, adequate treatment should be provided in accordance with the provisions of item 20 of this manual.

ITEM 5. CONSTRUCTION AND USE OF CASINGS AND CURBINGS

All ground water supplies shall have a properly constructed and installed outside watertight casing or curbing extending a safe distance above and below the ground surface.

Public health reason.—A properly constructed and installed watertight casing or curbing is essential to prevent the entrance of surface or subsurface contamination into the well.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) If metallic casings are used, the casing is new standard steel, wrought iron, or cast iron as specified in the following tables or equal, and the pipe sections are threaded or welded so as to be watertight.

(*a*) In establishing the depth of casing or curbing below the ground surface, the measurement is made from the established grade in the immediate vicinity of the source. The casing or curbing shall extend as far as practicable below the natural ground level, but not less than 10 feet, and excessive depths of fill should be avoided.

(*b*) The annular space between the outside well casing and the well hole, for drilled wells, is filled with not less than 1½ inches of impervious cement grout to a depth of at least 10 feet and to such greater depth as may be required by the health officer. Refer to appendix A for discussion of cement grouting of drilled wells.

(*c*) Telescoping casings of different diameters, in a drilled well, overlap at least 8 feet and the annular space between such casings is filled with not less than 1½ inches of impervious cement grout or with a lead packer to prevent admission of undesirable ground water or surface drainage.

(*d*) The outside casing is not used as a suction or working barrel for pump plungers.

(2) The casing extends not less than 6 inches above the established ground surface at the well or the floor of the pump house.

(3) If concrete pipe, vitrified tile pipe, cement asbestos pipe, galvanized well casing, corrugated metal pipe, or brick are used for curbings for wells or springs, the following requirements are satisfied:

(*a*) Vitrified tile pipe, cement asbestos pipe, galvanized well casing, corrugated metal pipe, and concrete pipe shall be surrounded by not less than 6 inches of concrete to a depth of at least 10 feet. The surrounding concrete wall shall be not less than 6 inches thick, properly reinforced, and the concrete shall be so placed as to be free from voids. Wherever practical, the wall shall be poured in one operation, but in no case shall there be a construction joint within 10 feet of the top of the curbing. Where construction joints are essential at points more than 10 feet below the ground surface they shall be left rough and shall be washed and brushed with neat cement grout prior to pouring concrete.

TABLE 3.—*Steel and wrought-iron well casing*

Nominal size in inches	Well casing					Couplings	
	Weight, pounds per foot (threads and couplings, inclusive)	Thickness in inches	Diameter in inches		Threads per inch	Length in inches	External diameter in inches
			Internal	External			
1	1.68	0.133	1.049	1.315	11½	1⅞	1.576
1¼	2.28	.140	1.380	1.660	11½	2⅛	1.950
1½	2.73	.145	1.610	1.900	11½	2⅜	2.218
2	3.68	.154	2.067	2.375	11½	2⅝	2.760
2½	5.82	.203	2.469	2.875	8	2⅞	3.276
3	7.62	.216	3.068	3.500	8	3⅛	3.948
3½	9.20	.226	3.548	4.000	8	3⅜	4.591
4	10.89	.237	4.026	4.500	8	3⅝	5.091
4½	12.64	.247	4.506	5.000	8	4⅛	5.591
5	14.81	.258	5.047	5.563	8	4⅛	6.296
6	19.18	.280	6.065	6.625	8	4½	7.358
8	25.00	.277	8.071	8.625	8	4½	9.420
10	35.00	.307	10.136	10.750	8	6⅛	11.721
12	45.00	.330	12.090	12.750	8	6⅛	13.958
14 OD	57.00	.375	13.250	14.000	8	7⅛	15.446
15 OD	61.15	.375	14.250	15.000	8	7⅛	16.446
16 OD	65.30	.375	15.250	16.000	8	7⅛	17.446
17 OD	73.20	.375	16.214	17.000	8	7⅛	18.683
18 OD	81.20	.375	17.182	18.000	8	7⅛	19.921
20 OD	90.00	.375	19.182	20.000	8	7⅝	21.706

Where pipe sections are connected by welded joints, threading and couplings are not essential.

TABLE 4.—*Threaded cast-iron well casing*

Well casing							Couplings	
Nominal diameter (inches)	Weight, pounds per foot	Wall, thickness in inches	Diameter in inches		Maximum length of string, in feet	Threads per inch	Length in inches	External diameter in inches
			Internal	External				
3	11.2	0.360	2.780	3.500	1,200	8	3¾	4.125
3	12.2	.360	3.155	3.875	1,200	8	3¾	4.750
3	12.7	.360	3.240	3.960	1,200	8	3¾	4.875
4	15.0	.370	3.760	4.500	1,200	8	4	5.250
4	17.0	.380	4.040	4.800	1,200	8	4	5.750
4	17.2	.380	4.240	5.000	1,200	8	4	6.000
5	18.5	.380	4.803	5.563	1,200	8	4¼	6.375
6	24.4	.400	5.825	6.625	1,200	8	4½	7.500
6	27.0	.430	6.040	6.900	1,200	8	4½	7.875
6	28.1	.430	6.240	7.100	1,200	8	4½	8.250
8	36.7	.460	7.705	8.625	1,400	8	5	9.625
8	42.0	.500	8.050	9.050	1,400	8	5	10.125
8	43.1	.500	8.300	9.300	1,400	8	5	10.625
10	52.1	.520	9.710	10.750	1,400	8	5¼	12.000
10	59.0	.570	9.960	11.100	1,500	8	5¼	12.500
10	60.5	.570	10.260	11.400	1,500	8	5¼	13.000
12	69.2	.580	11.590	12.750	1,500	8	5¾	14.125
12	77.0	.620	11.960	13.200	1,500	8	5¾	14.625
12	78.3	.620	12.260	13.500	1,500	8	5¾	15.250
14	99.0	.690	13.920	15.300	1,500	8	6¼	16.875
14	102.0	.690	14.270	15.650	1,500	8	6¼	17.625
16	122.0	.750	15.900	17.400	1,600	8	6¾	19.250
16	126.0	.750	16.300	17.800	1,600	8	6¾	20.000
18	152.0	.830	17.840	19.500	1,600	8	7	21.250
18	156.0	.830	18.260	19.920	1,600	8	7	22.375
20	179.0	.880	19.840	21.600	1,600	8	7½	23.625
20	183.0	.880	20.300	22.060	1,600	8	7½	24.625
24	243.0	1.000	23.800	25.800	1,600	8	8¼	28.125
24	248.0	1.000	24.320	26.320	1,600	8	8¼	29.250

Where pipe sections are connected by welded joints, threading and couplings are not essential.

The concrete used in the construction of any ground water supply units should be composed of 1 part Portland cement, 2 parts sand, and 4 parts gravel by volume. Clean, hard, tough, and durable aggregates should be used. The maximum diameter of aggregate particles should not exceed one-fifth of the minimum width between forms. Hydrated lime to the extent of 10 percent of the volume of cement may be added to increase fluidity and facilitate placement of concrete. The use of lime is particularly applicable in the case of concrete used for spring and dug well casings.

(*b*) Single brick walls. Single brick walls shall be surrounded by not less than 6 inches of concrete as described in paragraph (*a*).

(*c*) Double layer brick walls have an inch thick layer of 1 to 1 Portland cement mortar applied either to the exterior of the brick wall or between the two rings of brick. Both the vertical and horizontal joints in the two rings of brick are staggered. The brick is common brick, compact in texture, hard burned entirely through, sound and uniform in quality and free from lumps and cracks.

(*d*) Well and spring basin curbings extend at least 6 inches above the established ground surface.

(*e*) The peripheral space between a dug well or a spring basin curbing and the original earth formation is filled with thoroughly compacted clean puddled clay or equivalent materials.

(*f*) A separate inside pipe for conducting water from a well, commonly known as a drop pipe, is provided.

ITEM 6. GRAVEL TREATED WELLS

When gravel is placed in the annular space between the excavation line and the outside of the well casing, the gravel surface shall terminate a safe distance below the ground surface and the annular space above the gravel surface shall be filled with impervious material. It is desirable to disinfect the gravel used with a chlorine solution because it is practically impossible to do so after the gravel has been placed.

Public health reason.—Proper filling of the annular space between the excavation line and the outside of the well casing with impervious material for a safe distance above the gravel surface is essential to prevent contaminated surface water from reaching the source of supply through the gravel layer. The use of contaminated gravel may result in unsatisfactory bacteriological tests over a long period of time and even if this gravel contamination has no sanitary significance it may mask the true quality of the ground water source.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) The gravel surface terminates not less than 10 feet below the ground surface.

(2) The annular space between the excavation line and the outside of the well casing, above the gravel surface, is filled with thoroughly compacted puddled clay, mortar, or cement grout.

(3) Gravel used for treating wells is disinfected with a chlorine solution immediately before application to the well.

ITEM 7. COVERS, PLATFORMS, AND FLOORS

Every cover, pump platform, or pump room floor shall be watertight and elevated above the adjacent ground level and its surface sloped to facilitate the rapid removal of waste water.

Public health reason.—A properly elevated, watertight, well-drained cover or floor promotes cleanliness and is essential to divert contaminated surface water away from the source.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) The cover, pump platform, or pump room floor is made of reinforced watertight concrete.

(2) The concrete is sloped from the center of the well casing or pipe sleeve to the outer edges of the slab or the drain, and the slab at its outer edges is not less than 4 inches thick.

(3) In the case of drilled or bored wells equipped with hand-operated pumps, the concrete slab extends not less than 2 feet from the well casing in all directions.

(4) In case power pumps are mounted over the casing, the casing extends not less than 6 inches above the pump platform or floor and not less than 1 inch into the pump base in accordance with the provisions of item 11 (B) of this manual.

(5) In the case of hand pumps, the casing or pipe sleeve extends not less than 1 inch above the pedestal on which the pump base rests.

(6) The cover of a dug well or spring basin is watertight, properly grouted in place, and its edges extend at least 2 inches beyond the outer edge of the wall or curbing of the well or spring basin.

(7) In the case of drilled or bored wells, the cover, pump platform, or pump room floor rests on thoroughly compacted earth.

ITEM 8. WELL SEALS OR COVERS

Every well shall be provided with a watertight seal or overlapping cover at the top of the casing or pipe sleeve.

Public health reason.—A watertight seal or overlapping cover at the top of the casing or pipe sleeve is essential to prevent contaminated water or other deleterious material from entering the well through the annular opening at the top of the well casing or pipe sleeve.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) In case the pump and drop pipe are not installed immediately after the casing or pipe sleeve is installed, the top of the casing or pipe sleeve is provided with a watertight seal or overlapping cover at the top until the installation is completed and a permanent seal is provided.

All wells should be kept permanently sealed, or properly covered, at the top at all times, except when necessary to remove the seal for the purpose of inspection or to accomplish necessary installations, repairs, or other essential operations.

(2) The casing or annular opening between the casing and drop pipe is provided with a watertight seal or overlapping cover, making a watertight connection to drop pipe, at the top. This item shall be satisfied when a properly constructed pump base overlaps the casing or pipe sleeve at the top.

ITEM 9. WELL VENTS

Well vents shall be constructed and installed to retain atmospheric pressure conditions in the well casing and to prevent the entrance of contamination.

Public health reason.—Proper construction and installation of a well vent is essential to prevent the entrance of insects and contaminating material into the well. Creation of a partial vacuum within the well might tend to introduce pollution or cause collapse of the well wall or casing.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) Every well in which the draw-down is 10 feet or more, and which has equipment or appurtenances installed therein, is provided with an adequate air vent.

(2) The air vent is constructed of metal tubing or pipe and connected so as to be watertight.

(3) The open end of the vent is screened and terminated in a downward direction through use of an elbow or equivalent means and the lower end of the outlet is not less than 12 inches above the top of the well casing, and in no case less than 18 inches above the floor of the pump room.

The vent shall be screened with 16-mesh brass or bronze screen, or holes ¼ to ½ inch in diameter may be drilled in the capped, downward directed portion of the vent pipe and 16-mesh brass or bronze screen tightly fitted over these holes. The cross-sectional area of these holes should be at least equal to the cross-sectional area of the vent pipe.

ITEM 10. WELL PITS

Wellheads, well casings, pumps, pumping machinery, exposed suction pipes, or valve boxes connected with a suction pipe shall not be located in any pit, room, or space extending below the ground surface: *Provided*, That existing pits may be provisionally accepted only if constructed in accordance with the requirements of the State health department.

Public health reason.—Excavations or subsurface structures such as well pits provide means for the accumulation of contaminated surface or shallow subsurface water which may contaminate the water supply.

A number of sanitary pitless underground pumps are available on the market which eliminate the installation of underground discharge pumps in pits for frost protection. Standard parts can be purchased and assembled in such a way as to accomplish the same results. The need for frost pits may be avoided by the use of bleeders or weep holes located in the drop pipe at a point below the frost line in order that the water in the pump and drop pipe may run back into the well after pumping has been discontinued. The need of locating pump room floors below the ground level may be avoided by providing an insulated pump house to protect the pumping equipment and appurtenances from freezing. If additional protection is essential during unusually cold weather, it can be provided at a nominal cost by installing a thermostatically-controlled electric heater or other types of heating units in the pump house.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) In the case of new installations, wellheads, well casings, pumps,

pumping machinery, valve boxes connected with a suction pipe, or exposed suction pipes are not located in any pit, room, or space extending below ground level: *Provided*, That submersible pumps constructed to operate below the water level within the well casing may be installed on approval of the health officer.

(2) In the case of existing ground water supplies, such pits housing wellheads, well casings, pumps, pumping machinery, suction pipes, or valves connected with a suction pipe shall be accepted provisionally only if constructed or reconstructed in accordance with requirements of the State health department. It is recommended that provisionally accepted pits conform with the following minimum requirements as well as with any requirements set up by the State health department for their approval of specific installations:

(*a*) Pits shall be of watertight construction with walls extending at least 6 inches above the established ground surface at all points.

(*b*) Pits shall be provided with a watertight concrete floor sloping to a drain which discharges through a cast-iron line not less than 4 inches in diameter to the ground surface at a lower elevation than the pit, and at least 30 feet from it; or if this is impossible, to a watertight concrete sump, in the pit, equipped with an automatic sump pump discharging through a steel or cast-iron line to the ground surface at least 30 feet from the pit. (See item 12(B).)

(*c*) Pits shall be provided with a concrete base for pumps, or pumping machinery, so that such units shall set at least 12 inches above the floor of the pit.

(*d*) Pits shall be provided with a satisfactory housing or cover in all cases.

ITEM 11. CONSTRUCTION AND INSTALLATION OF PUMPS

All water pumps shall be so constructed and installed as to prevent contamination of the water supply.

Public health reason.—Proper construction and installation of pumps is essential to prevent contamination from entering the well by means of the pump or pump mounting.

ITEM 11 (A). HAND PUMPS

Hand pumps may be mounted by setting the pump over the pipe sleeve and anchoring the base of the pump to the concrete pedestal or by mounting the base of the pump on a metal flange which is anchored rigidly to the pipe sleeve. The latter method of mounting a hand pump is preferable, inasmuch as this method provides a more permanent and rigid connection which is easily accessible when repairs are made. Hand pumps which are anchored to the concrete pedestal by means of nuts and bolts become loosened, resulting in an unsatisfactory

installation. Where a hand pump is mounted on a flange, the pipe sleeve should extend at least 6 inches above the top of the concrete platform.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) Hand pumps are of the force type with cylinders placed below or near the water level so that priming is not necessary.

(2) The pump base is watertight and of the solid one-piece recessed type, cast integrally with or threaded to the pump column or stand.

(3) The pump base is of sufficient diameter and depth to permit the well casing to extend not less than 1 inch into the base of the pump.

(4) The pump base is rigidly fastened to a metal flange by means of bolts and nuts, or by equivalent means.

(5) The pump head is of the closed type provided with a pump rod stuffing box.

(6) The pump spout is of the closed downward directed type.

(7) Suitable gaskets are used between the pump base and the flange to insure a watertight joint.

ITEM 11 (B). POWER PUMPS

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) Any pump or power unit placed immediately over the well casing or pipe sleeve has a watertight metal base to form a cover for the well. The base plate is recessed on the underside to permit the casing or pipe sleeve to extend into it at least 1 inch above the level of the concrete foundation upon which the base of the pump or power unit rests, thus forming an overlapping cover with edges projecting below the top of the casing or pipe sleeve.

Where necessary the casing head can be enlarged or decreased in diameter by means of a pipe sleeve extension securely attached to the casing so as to be watertight. On flat base plates and other shapes where radial ribs interfere, a skirt projecting downward at least 1 inch below the top of the well casing may be welded to the outside edge of the base plate to form the overlapping cover for the well casing.

In installations having an open type pedestal for pump or power unit and having ample space to permit installation and removal of a watertight metal cover or of a lead packing or of a seal of sand and asphalt compound or cement grout, this type of closure may be used in lieu of the base plate type of cover, specified above, for the annular space between the suction pipe and the well casing. The well casing must extend at least 6 inches above the established ground surface at the well or the floor of the pump house, as required in paragraph (2) of item 5 of this manual.

(2) In the case of power pumps which are not placed directly over the well, the well casing extends at least 6 inches above the established ground surface at the well or the floor of the pump house and the annular space between the well casing and suction pipe is closed with a watertight cover or lead seal to prevent the entrance of contamination into the well.

(3) In case a submersible pump is installed within the well casing below the water level, the motor is enclosed completely in a watertight metal casing constructed to prevent oil from coming in contact with the water, and the oil is conveyed to the motor housing through noncorrodible heavy metal tubing.

(4) Any opening in the base plate of the pump or annular opening made by passing a pipe through the pump base is made watertight to a point above the spill line of the webbing around the plate. Such an opening may be threaded and a nipple extending above the spill line of the webbing screwed into it. The annular opening between the nipple and pipe passing through it may be leaded, fitted with a stuffing box and packing, or provided with an overlapping cover welded to the pipe. If there are any other openings in the base plate they are threaded and fitted with metal screw plugs.

(5) The pump or power unit base is anchored rigidly to the well casing or the pump platform.

(6) The discharge tee, check valve, and gate valve are located above the pump room floor.

(7) The discharge line from a power pump is provided with a sampling cock with the outlet terminating in a downward direction.

ITEM 12. PUMP HOUSE

The pump house shall be constructed properly to prevent flooding, shall be provided with adequate floor drainage, and if plumbing fixtures are to be provided they should be designed and installed properly.

ITEM 12 (A). CONSTRUCTION TO PREVENT FLOODING

Public health reason.—Proper construction of the pump house is essential to eliminate the possibility of the interior of the structure being flooded during emergencies.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) The pump house is provided with a doorway and a door at least 6 square feet in area which opens outward and extends to the floor.

(2) Pump houses located on side hill slopes have not less than 50 percent of the floor area above ground level and the door located on that part of the floor above ground level.

ITEM 12 (B). DRAINAGE OF FLOORS

Public health reason.—A well-drained concrete floor promotes cleanliness and facilitates the removal of waste water.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) A floor drain is provided and is constructed of cast iron or equivalent material with an outlet not less than 4 inches in diameter.

(2) The inlet to the floor drain is located not less than 2 feet from the outer edge of the casing or pipe sleeve.

(3) A cast-iron pipe line with watertight leaded joints is connected to the floor drain and carried to a point not less than 4 feet outside the building walls and connected to other suitable pipe which discharges onto the ground surface not less than 30 feet from the source: *Provided,* That where the drain line cannot be extended to the ground surface on a uniform grade toward the outlet, the line may discharge into an absorption pit located not less than 30 feet from the source. The drain line should be laid at a grade toward the outlet of not less than ⅛ inch per foot, except that for a floor drain installed for the purpose indicated and in the manner specified in this item (12 B), the requirements of item 3, "Distances to Sources of Contamination," shall not apply thereto. However, such drains shall not be connected to a storm or sanitary sewer; they may discharge to the ground surface or to a dry well which is well removed from contact with sewage or other wastes.

ITEM 12 (C). PLUMBING FIXTURES IN PUMP HOUSE

Public health reason.—Properly designed and installed plumbing fixtures will eliminate the public health hazard caused by the back siphonage of contaminated liquid wastes from faulty plumbing fixtures into the water supply piping.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) Toilets, sewers, soil pipes, or drains are not located on the first floor directly above the pump room floor, or where leakage therefrom can reach any source of water supply or pump room.

(2) The locations of toilets, sewers, soil pipes, or drains in the pump house are approved by the health officer, and the installation conforms to the requirements of item 3 of this manual, "Distances to Sources of Contamination."

(3) All plumbing fixtures comply with the Federal Specifications for Plumbing Fixtures, March 1940, WW–P–541a, or its equivalent. The requirements of these specifications with respect to air gaps and backflow preventers are strictly enforced.

ITEM 13. LUBRICATION OF PUMP BEARINGS

Pump bearings situated in any well below the pump room floor or platform shall be lubricated with water of a safe sanitary quality.

Public health reason.—Lubrication of pump bearings, situated in a well below the pump room floor, with oil, grease, or water other than of a safe sanitary quality may result in contamination of the water supply.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) Pump bearings situated in any well below the pump room floor or platform are lubricated with water taken from within the well, or reservoir, or distribution system supplied with water from the original source of water supply, or from another supply which meets with the requirements of the health officer.

(2) In the case of existing installations using oil-lubricated bearings, the oil is stored and handled so as not to expose it to contamination.

ITEM 14. PRIMING OF POWER PUMPS

Priming type power pumps shall be primed with water of a safe sanitary quality applied from properly protected equipment.

Public health reason.—Priming of power pumps with water other than of a safe sanitary quality may result in contamination of the water supply as the result of priming water being forced into the distribution system.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) Power pumps are primed with water taken from the original source for which the pump is used or from a reservoir or distribution system supplied with water from the original source of water supply or from another supply which meets the requirements of the health officer.

(2) Priming devices are so constructed and installed as not to expose the water to dust, drippings, or other sources of contamination.

ITEM 15. PROTECTION OF SUCTION PIPES

All subsurface suction piping leading from detached wells or reservoirs shall be protected adequately against the entrance of contamination.

Public health reason.—The suction created in the pipe line when water is pumped may result in contaminated ground water or surface water being drawn into the line through breaks or defective joints in the suction line.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) The pumps are placed directly over the well, sump, or reservoir wherever practicable, and the suction pipe, where located above ground, is in a frostproof box.

(2) In the case of a suction pipe rising to a pump house the outer casing extends not less than 6 inches above the platform or floor surface.

(3) The annular space between the protective casing pipe and the suction pipe is provided with a watertight seal at the top.

(4) Subsurface suction piping is not less than 10 feet below the ground, either natural or fill.

(5) All that part of any suction piping within 10 feet of and below the ground surface is surrounded by a watertight outer casing pipe or protected by equivalent means. In case of filled ground, an outer protective casing shall be used, regardless of depth of suction pipe.

Frequently the discharge lines of well pipes are under negative pressure. This is caused by water running back down into the well when the pump stops. These sections of pipe should be protected against contamination by methods similar to these recommended for suction pipes.

ITEM 16. VALVE BOXES

Every valve box on a buried suction pipe line shall be constructed and installed properly.

Public health reason.—Proper construction and installation of valve boxes are essential to prevent contaminated surface water from entering the valve box and accumulating around the valve. Valves submerged by surface water may result in contamination being drawn into the suction line through defective valves and connections.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) Valves located on buried suction lines are protected with valve boxes which project not less than 6 inches above the floor if in a building or room, and not less than 12 inches above the ground surface if not enclosed in a building.

(2) The tops of all such valve boxes are provided with watertight overlapping covers.

(3) In case valves are installed on buried suction lines located 10 feet or more below the ground surface, the valve box is watertight for not less than 10 feet below the ground surface, and when the space between the valve box and the natural ground formation is filled with compacted puddled clay or equivalent materials.

(4) In case valves are installed on buried suction lines located less than 10 feet below the ground surface, the valve is enclosed completely in a watertight valve box. When valves cannot be enclosed completely in a valve box, the box shall be watertight and the opening between the base of the valve box and the valve dome or cover shall be sealed so as to be watertight.

Valves on buried suction lines should be avoided wherever possible by placing suction pipes above the pump room floor or above the ground surface.

ITEM 17. MANHOLES AND COVERS

Every manhole opening on spring structures, dug wells, or valve chambers shall be curbed above the adjoining surface and provided with an overlapping watertight cover.

Public health reason.—Manhole openings that are curbed and provided with an overlapping watertight cover are essential to prevent contaminated surface water from entering the manhole opening.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) The manhole opening is curbed to a height of at least 6 inches above the adjoining surfaces.

(2) The manhole cover is watertight and overlaps the curbing and extends downward around it for not less than 2 inches.

(3) The manhole cover is kept in place by means of a hasp and lock, or by equivalent means.

(4) In case metal manhole covers are provided, the covers are welded, formed, or molded to form the overlap for the manhole opening and the metal shall be at least 12 gage.

ITEM 18. AIRLIFT SYSTEMS

The air compressor and appurtenances for any airlift system or mechanical aerating apparatus used in connection with a ground water supply shall be installed and operated properly.

Public health reason.—Proper construction, installation, and protection of air compressors and appurtenances is essential to prevent the entrance of insects, birds, or other contaminating materials, and to minimize the entrance of dust.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) Watertight metal tubing, pipe, or equivalent materials are used for air intakes.

(2) The open end of an air intake of any airlift system or mechanical aerating apparatus is not less than 6 feet above the floor surface if indoors, 10 feet above the ground surface if outdoors, and 2 feet above a roof of a building through which it may project.

(3) The open end of the air intake is screened with 16-mesh brass or bronze screen, terminated in a downward direction, and an air filter installed in the intake line.

(4) The air compressor is located in a room as free as possible from dust and at such elevation that flooding of the equipment will be made impossible.

(5) The compressed air from the compressor is discharged into an air storage tank, oil trap, or filter designed to remove from the compressed air oil or oil mist which may have entered during its passage through the compressor.

ITEM 19. CROSS-CONNECTIONS

There shall be no physical connection between a safe public ground water supply and any other water supply not of equal sanitary quality and under as rigid official supervision, and there shall be no connection or arrangement by which unsafe water may enter a safe public ground water supply system.

Public health reason.—This item is important, inasmuch as cross-connections have been found to be one of the principal causes of water-borne disease outbreaks. Wolman's and Gorman's figures show that during a 7-year period (1930–36) 14 reported water-borne outbreaks resulting in 139 cases of typhoid fever and 563 cases of diarrhea were due to cross-connections between safe and polluted water supply systems.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

There are no cross-connections, backflow connections, emergency intakes, bypasses,[1] or other arrangements by means of which polluted water or water of unknown or questionable quality may enter a safe public ground water supply system: *Provided*, That water of a safe sanitary quality may be supplied to any other system containing water of questionable quality only by means of an independent line discharging at least two pipe diameters and not less than 6 inches above the rim of storage units open to atmospheric pressure.

ITEM 20. BACTERIOLOGICAL, PHYSICAL, AND CHEMICAL QUALITY OF WATER

The bacteriological, physical, and chemical quality of water furnished to consumers from a public ground water supply shall be not less than the requirements of the Public Health Service[2] for drinking and culinary water used on common carriers operating in interstate commerce; when necessary, the water shall be treated to conform with the Public Health Service requirements.

Public health reason.—Diseases such as typhoid fever, cholera, dysentery, and other enteric diseases may be transmitted through the use of contaminated drinking water, and physiological disturbances may occur from the use of chemically or physically unsatisfactory water.

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[1] These terms are defined in section 1 of this manual.

[2] Reprint No. 2440, Public Health Reports. Available from Superintendent of Documents for 10 cents.

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Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) Untreated waters meet in all respects the requirements of this manual. Only those supplies meeting the bacteriological, physical, and chemical requirements of the United States Public Health Service Drinking Water Standards as shown by satisfactorily regular and frequent sanitary inspections and laboratory tests shall be approved for use without treatment.

(2) Public ground water supplies subject to a low degree of contamination (average coliform content of not more than 50 per 100 ml. in any month), but otherwise meeting all requirements of this manual, are given treatment consisting of chlorination and storage.

Chlorination facilities including equipment, control, and operating procedures shall be approved by the health officer. Free chlorine should be in contact with the treated water for not less than 20 minutes, or chloramine preferably for at least 3 hours before the treated water reaches the first consumer. Where necessary, baffle walls shall be used to prevent short-circuiting of the water from the inlet to the outlet of the detention reservoir so that the water will remain in the reservoir for the full flow-through period of time. The treated effluent shall meet the bacteriological requirements of the Public Health Service Drinking Water Standards.

Treatment shall be employed when there is a possibility of contamination reaching the water supply source and rendering it unsafe for domestic use. Treatment, however, should not be used permanently to overcome a defect of construction which can and should be corrected.

Where a treated underground supply is in use and an equally good untreated supply can be obtained, the treated supply shall be considered as temporary, to be used only until the untreated supply can be made available. Treatment may then be used as an additional safeguard.

On a site where the earth formations permit the rapid movement of ground water, such as coarse gravel, fissured rock, solution channels, and similar formations, the ground water cannot be considered safe, and adequate treatment shall be provided.

(3) Treatment consisting of sedimentation, filtration, and disinfection is provided for waters containing numbers of coliform bacteria averaging over 50 per 100 ml. but not more than 5,000 per 100 ml. in any month and exceeding 5,000 per 100 ml. in not more than 20 percent of the samples examined in any month.

Treatment processes, operation, and control for this class of water shall be approved by the State department of health. The treated

effluent shall meet the bacteriological requirements of the Public Health Service Drinking Water Standards.

(4) Ground water supplies subjected to softening treatment or treatment for mineral removal employing various processes using chemicals in contact with the water, aeration, filtration, and similar methods are chlorinated before delivery for consumption.

ITEM 21. PLANT SUPERVISION AND CONTROL

All public ground water supplies shall be under the supervision and control of a competent operator.

Public health reason.—A competent operator is essential to prevent contamination of the water supply during reconstruction work, repair to equipment and appurtenances, or in the operation of the plant.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) All plants are under the supervision of a competent operator approved by the health officer, and in those States which have licensing requirements for waterworks operators, such requirements are met by the operator.

(2) In case of untreated ground water supplies, the operator is available on call in any emergency.

(3) In case the treatment of the water consists of chlorination and storage only, the operator visits the plant not less than twice each day and is available on call in any emergency.

(4) In case additional treatment of the water supplements chlorination and storage, the supervision of the plant meets the requirements of the health officer.

(5) In case of treated ground water supplies, the operator keeps records essential to the control and operation of the plant and submits copies of such records as the health officer may require.

ITEM 22. WATER SAMPLING

Chemical analyses and bacteriological examinations of water samples and tests for residual chlorine shall be made by approved methods and at proper intervals.

Public health reason.—Chemical analyses and bacteriological examination of water samples and tests for residual chlorine are essential to guide the operator in running the plant and to determine whether the water is of satisfactory sanitary quality.

The recommended minimum intervals at which samples should be collected from all ground water supplies for bacteriological examina-

tion and residual chlorine tests are presented in the following tabulation:

Type of treatment	Minimum interval of sampling for— Bacteriological examination [1]	Residual chlorine tests
None	1 month	
Chlorination and storage only	1 week	At least once in each successive 8-hour period.
Aeration, sedimentation, and filtration, or any combination thereof with chlorination and storage	Daily	Do.

[1] The number of bacteriological samples to be collected from the distribution system per month should be in accordance with the requirements of the Public Health Service Drinking Water Standards as indicated in figure 1.

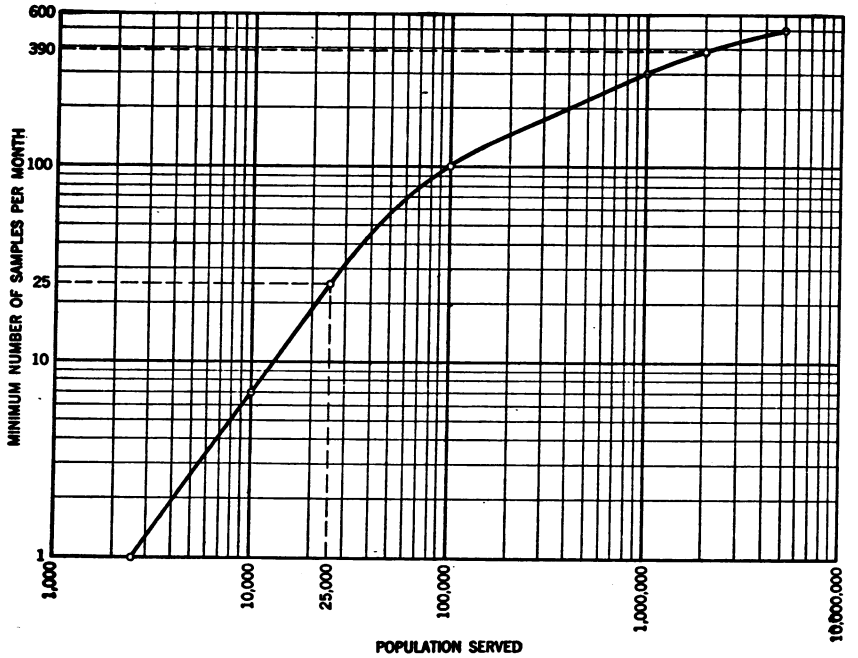

FIGURE 1

In addition to bacteriological examinations and residual chlorine tests for underground water supplies requiring aeration, sedimentation, and filtration, or any combination thereof with chlorination and storage, the following laboratory tests should be made at frequent intervals where they are essential to control the treatment plant operation: temperature of air and water, turbidity, color, alkalinity, hydrogen-ion concentration (pH), and hardness. Occasionally special tests may be necessary such as for residual alum, iron, manganese, or other undesirable constituents of the final effluent. Where prechlorination is used in addition to postchlorination, tests for residual chlorine should be made at each major stage of treatment, and, in the raw water, test for chlorine demand.

For operational control at the plant, the frequency of tests, particularly for turbidity, residual chlorine, bacterial count, and coliform organisms, though dependent on the character of water treated and on its variability, should be such that at least one test each 24 hours and every day of the week will be carried out. For the larger plants, at least three sets of samples are usually collected daily for bacteriological tests. Determinations of turbidity and residual chlorine are made more frequently, sometimes at hourly intervals when the character of the raw or partly treated water is changing rapidly.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) All physical, chemical, bacteriological, and biological tests are made in conformity with "Standard Methods for the Examination of Water and Sewage," American Public Health Association, 8th Edition, 1936.

(2) Bacteriological and chemical tests of water samples from a newly developed or constructed ground water supply are made at least once following disinfection. The supply shall not be used for domestic purposes, where adequate treatment has not been provided, until the report on the bacteriological examination of water samples indicates that the water is of a safe sanitary quality.

(3) All ground water supplies are sampled for bacteriological, chemical, and physical tests at such intervals as the health officer may require.

ITEM 23. ABANDONMENT OF WELLS

Permanently abandoned wells shall be adequately filled with selected material to protect the water-bearing formation against possible contamination.

Public health reason.—Adequate filling of a permanently abandoned well is essential to prevent contamination from being introduced into the water-bearing formation through an abandoned well, which may result in contamination of existing or future ground water supplies in the vicinity.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) Drilled or cased wells are filled completely with neat cement grout, concrete, or clean puddled clay.

(2) Driven wells are filled completely with neat cement grout, concrete, or clean puddled clay.

(3) Dug or bored wells are filled completely with puddled clay or its equal after as much as possible of the curbing is removed.

ITEM 24. DISTRIBUTION

The distribution system shall be designed and constructed so as to prevent leakage of water due to defective materials, improper jointing,

corrosion, settling, impacts, freezing, or other causes. Adequate valves and blow-offs, properly installed, shall be provided so that necessary repairs can be made with a minimum interruption of service.

Public health reason.—Proper design and construction of the distribution system are necessary in order to deliver a safe water, to guard against contamination of water in the mains from outside sources, and to prevent leakage under conditions of decrease in pressure or negative pressure, and during repairs, break-downs, and installation of new mains.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) Cast-iron water mains are laid in accordance with the "Specifications for Laying Cast-Iron Pipe," adopted by the American Water Works Association (see Journal of the American Water Works Association, vol. 30, No. 2, February 1938).

(2) Trenching operations are conducted so that the contents of sewers and drains do not enter the trench.

Measures should be taken to prevent defecation and urination in the trench. Suitable sanitary conveniences should be provided for the workmen, and wherever practicable such sanitary facilities should be connected to the sewers. Proper trench drainage should be provided and the end of the pipe should be kept closed except when joints are being made.

(3) Newly laid pipe lines, before covering, are tested under a hydrostatic pressure 50 percent in excess of the normal operating pressure after expelling all air from the pipe. The duration of each pressure test shall be at least 30 minutes.

All exposed pipes, fittings, valves, hydrants, and joints should be carefully examined during the open trench test. All joints made with lead showing visible leakage should be recaulked until tight. Where the joints are made with sulfur compound or with cement and show seepage or slight leakage only such joints as may be defective should be cut out and replaced. Any cracked or defective pipes, fittings, valves, or hydrants discovered in consequence of this pressure test should be removed and replaced with sound material, and the test should be repeated until the pipe installation is satisfactory.

Suitable means should be provided for determining the quantity of water lost by leakage under normal operating pressure. No pipe installation should be accepted until or unless this leakage (evaluated on a pressure basis of 150 pounds per square inch) is less than 100 gallons per 24 hours per mile of pipe per inch nominal diameter for pipe in 12-foot lengths, 75 gallons for 16-foot lengths, and correspondingly varied for other lengths of pipe. In calculating leakage, allowance should be made for added joints in the pipe line above those incidental to normal unit lengths of pipe.

(4) Jointing materials are free from oil, tar, or greasy substances, are disinfected before use, examined bacteriologically after disinfection for freedom from coliform organisms, kept free from contamination, and applied dry; and when jointing materials will produce watertight joints, under all conditions to which the joint will be subjected.

(5) Water pipes are not laid in water, or where they can be flooded with water or sewage in laying, wherever this is practicable. When necessary to lay water lines below the water table or in wet ground, additional protection shall be provided for the joints, to insure watertightness, to the satisfaction of the health officer.

(6) Water mains crossing or laid near railroad tracks are constructed so that the pipe joints have a reasonable degree of flexibility and remain watertight.

The pipe line should be of such strength and tightness as to remain watertight under the loading and vibrations to which it will be subjected. Mechanical joints with rubber gaskets are suitable for such conditions. It is advisable in such situations to consult the railroad company and obtain approval for the crossing in advance of construction work.

(7) Laying of water pipes under water or under the bed of a stream is avoided and the crossing made on bridges, dams, or other structures sufficiently elevated so that the pipe will not be subject to immersion at any time, whenever this construction can be provided.

Above water crossings:

In cases where it is practicable to secure a satisfactory overhead crossing, particularly on bridges, consideration shall be given to the following items:

(*a*) The use of flexible pipe joints to maintain tightness under forces due to vibration and temperature variations and to prevent breaks and leaks at the points where the mains make sharp bends in leaving and returning to the ground.

(*b*) Protection of pipe from impact of runaway vehicles.

(*c*) Protection of pipe from flood waters or objects carried by flood waters.

Under water crossings:

In special cases where it is impossible or impractical to secure a satisfactory overhead crossing special construction to provide additional safeguards is necessary. These safeguards are briefly as follows:

(*a*) The pipe should not be laid on the stream bed or in the body of water. If an under crossing is made, it should be placed sufficiently far below the bottom of the body of water to protect the pipe against freezing and being moved by currents, ice, floating objects, anchors, dredges, or being otherwise disturbed. The distance below the stream bed should not be less than 5 feet.

(*b*) The pipe should be of special construction having flexible watertight joints.

(*c*) All pipe lines in under-water crossings should be provided with valves at both ends of the crossing so that the section can be isolated. The valves should be so located that they will not be subject to flooding.

(*d*) Permanent equipment should be installed for making periodic or continuous pressure tests for detecting leakage of the crossing.

(*e*) Sampling taps should be installed at each end of the crossing for the collection of samples for bacteriological examination.

(*f*) Provision should be made to blow off such sections of pipe to waste above ground level.

(*g*) Consideration should be given to the construction of under-water crossings in duplicate in order that continuous service and adequate pressure may better be maintained. Properly drained pipe tunnels deserve consideration because they facilitate inspection, repairs, and detection of leaks.

(8) Water lines are laid in trenches separated by at least 10 feet of solid earth from sewer lines.

(9) Water pipes are laid, so far as possible, above the elevation of nearby sewers and at least 10 feet laterally from them. Where this requirement cannot be met because of physical conditions, extra precautions are taken in securing absolute and permanent tightness of water pipe joints.

(10) Newly installed water mains are flushed thoroughly to waste through hydrants or other approved means to remove all dirt and foreign matter. The mains are disinfected in accordance with the following procedure and bacteriological tests indicate that the water conforms with the bacteriological requirements of the United States Public Health Service Drinking Water Standards before water conveyed in the mains is used for domestic consumption.

Disinfection procedure:

After flushing the mains, introduce chlorine and water so that the mixture of water and chlorine entering the pipe shall contain a chlorine concentration of at least 50 p. p. m. Retain treated water in the pipes long enough to destroy all nonsporeforming bacteria. The period of detention should be at least 3 hours and preferably longer. After the chlorine-treated water has been retained for the required time the chlorine residual at pipe extremities and at other representative points should be at least 5 p. p. m. If the residual is less than 5 p. p. m., the procedure should be repeated until a 5 p. p. m. residual is obtained. Upon completion of the disinfection process the water containing residual chlorine should be flushed from the system of pipes under treatment and water samples collected for the bacteriological examination mentioned above.

(11) All new plumbing is installed in accordance with the provisions of the State plumbing code and all existing plumbing which is not properly designed or properly installed, or both, is changed to conform with the State plumbing code as soon as the opportunity to do so presents itself.

Where State plumbing codes are not in effect the provisions of the "Plumbing Manual," Report BMS 66, issued by the National Bureau of Standards, should be followed. During the war emergency use of substitute materials for critical items required in BMS 66 will be permitted in accordance with requirements of the War Production Board.

(12) The water service pipe is watertight and corrosion-resistant. Copper pipe and cast-iron pipe with specially protected joints such as cast-iron pipe with bell joint clamps are recommended.

Where a water service pipe crosses a street sewer at less than 6 feet vertically above the sewer, or is within 10 feet of it horizontally, all that part of the water pipe lying within these distances should be constructed preferably of copper or brass pipe connected to the iron pipe with a brass fitting. In such cases it is preferable to use copper or brass pipe from the water main to the house, and the house sewers should be constructed of extra heavy cast iron with watertight joints. (During the war emergency where priorities necessitate the use of materials other than brass or copper, extra heavy iron pipe should be used under these conditions.)

(13) The handling, repairing, testing, and installation of water meters are carried out in such a manner as to prevent introduction of contamination into the water supply system.

Before meters are installed they should be disinfected unless they are disinfected together with adjacent pipe before the system is placed in service. If meters are disinfected some considerable time before they are placed in the pipe line, the inlets and outlets should be capped to prevent the entrance of dirt, dust, or other contaminating material. Meters may be disinfected by passing a solution of chlorine of about 50 p. p. m. strength into the meter and keeping it in contact with the parts for at least 5 minutes.

(14) Hydrant drains are not connected to sanitary or storm sewers but are connected to dry wells or drain to the surface of the ground. Wherever practical, the hydrant drain should be plugged and arrangements made to pump out the hydrants after use.

(15) Chambers or pits containing gate valves, air relief valves, blowoffs, or other such appurtenances to a distribution system are not connected directly to any sanitary or storm sewer, and blow-offs are not connected directly to any sewer.

(16) Booster stations on the distribution system are located in rooms that have floors above ground level and are so designed and located that they will not cause a negative head in the distribution piping.

In some cases it may be necessary to provide a receiving reservoir from which the water can be drawn instead of drawing suction directly from the mains.

(17) In case it is necessary to supply water from the mains of a water system that is known to be safe to some other system which is unsafe, the water is delivered through a pipe to a tank or reservoir connected to the unsafe system in accordance with the provisions of item 19 of this manual.

(18) The piping system is designed and installed to maintain a positive pressure in all its parts under normal usage at all times.

(19) The system is designed so as to afford effective circulation of water with a minimum of dead ends.

ITEM 25. STORAGE

All reservoirs and storage tanks shall be of sanitary and watertight construction and made of concrete, steel, wood, or other materials approved by the health officer: *Provided,* That wood shall not be used for reservoirs or storage tanks located wholly or partly underground. Reservoirs and storage tanks shall be located at safe distances from sources of contamination.

Public health reason.—Water which is safe and of approved quality at the source may be contaminated in storage units unless precautions are taken to prevent entry of shallow ground water, surface flood waters, or other pollution.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) Ground water storage units are watertight. When such units are made of concrete they shall be adequately reinforced to prevent development of cracks; where construction joints are necessary, adequate water stops, approved by the health officer, shall be installed. If such units are made of steel they shall be protected against corrosion. Painting [3] of steel tanks usually affords protection from corrosion for a number of years. Cathodic protection is another method used for corrosion protection of metal tanks.

(2) All such water storage units are located at satisfactory distances from sources of contamination. In ascertaining such safe distances the requirements of item 3 of this manual shall be followed.

(3) All such water storage units are equipped with watertight covers, and manhole openings in such covers comply with the requirements of item 17 of this manual.

(4) All such ground water storage units are located and protected so that there is no danger of contamination by surface drainage or flooding.

[3] Tentative Standard Specifications for Elevated Steel Water Tanks, Standpipes and Reservoirs. J. Am. Water Works Assoc., 32: 39-42, (December 1940).

(5) Air vents in storage units are constructed of metal tubing or pipe connected so as to be watertight, and the open end of the vent is screened with 16-mesh brass or bronze screen and terminated in a downward direction by means of an elbow or equivalent means and the lower end of the outlet is not less than 12 inches above the roof of the storage unit, nor less than 24 inches above the established ground elevation.

(6) Overflows and water-level control gages are constructed so as to prevent the entrance of birds, insects, or contaminating materials, and when all openings are screened with 16-mesh brass or bronze screen and hooded or otherwise protected to prevent contaminating material from entering the opening.

(7) Overflows, blow-offs, or clean-out pipes, and drains from the roof or bottom of storage units are not directly connected to sewers.

Such pipes may discharge onto ground surface or into an open receptacle from a point at least 6 inches above the rim of the receptacle. The receptacle should be situated at ground surface and at least 50 feet from the reservior and may be connected to sewers.

(8) Storage units are located so that traffic will not pass over them.

(9) New reservoirs or tanks or such units which may have been contaminated or subjected to the possibility of contamination as during cleaning, alteration, painting, or repairing operations are disinfected before water from them is used for domestic consumption. The following procedure, recommended by the Minnesota Department of Health, is suggested as a satisfactory method of disinfection:

The underside of the roof should be washed down even though it is not normally in contact with the water. Since only the floor and walls are in contact with the water these parts should be given special attention. A given amount of chlorine is more effective if applied in concentrated solution to the walls and floor of the reservoir or tank with a brush or spray than if placed in a tank full of water.

Scattering dry powdered chlorinated lime onto the walls and the floor of the reservoir when it is empty and then filling it with water to the overflow is also fairly effective. Where a chlorine solution of high concentration (100 p. p. m.) is used on the walls and floor, it should be rinsed off by washing down the walls and the floor with a stream of water, and this water wasted. Any adjacent valves on pipe lines connected to the reservoir should be operated so as to bring the chlorine solution to all parts that come in contact with water in the pipe. When this has been done sufficient chlorinated lime should be placed in the reservoir to produce a residual of at least 1.0 p. p. m. at the end of a 3-hour holding period. The reservoir should then be filled with water to the overflow. After the treated water is held in the reservoir for at least 3 hours it may be turned into the distribution system. One part per million for 100,000 gallons of water will require 1.25 pounds of chlorinated lime of 66 percent available chlorine.

Reservoirs should always be disinfected after they have been altered, painted, or repaired. When the contamination is known to be limited, the disinfection may be accomplished by adding the chlorine to the reservoir full of water. The water may then be used in the distribution system.

Reservoirs may be utilized in providing large volumes of chlorinated water

for the purpose of disinfecting the pipe lines of the distribution system or parts of it.

For disinfecting purposes pressure tanks should be provided with an air-relief valve and an overflow on the top so that all air can be expelled from the tank and the entire surface of the interior brought into contact with water containing a high residual of chlorine.

ITEM 26. PROTECTION DURING CONSTRUCTION

All public ground water supply systems which are hereafter constructed, reconstructed, or extensively altered shall be adequately protected to prevent contamination of water at the source or in the system during construction.

Public health reason.—The diversion of surface water away from the source and the use of water of a safe sanitary quality during construction is essential to prevent contamination of the ground water supply.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) All surface water is properly diverted away from the source during construction.

(2) All water used for construction is obtained from a known safe source, or adequately disinfected.

ITEM 27. DISINFECTION AFTER CONSTRUCTION AND REPAIR

Underground water supplies shall always be disinfected following new construction or repair work, to remove all traces of contamination.

Public health reason.—Water from newly developed ground water supplies and existing supplies which have been subjected to changes and repairs often shows an unsatisfactory sanitary quality as indicated by bacteriological examination of samples collected from the source. This is usually due to contamination from workmen, equipment, materials, or surface water which may be introduced into the ground water supply during the process of construction or repair work. While such contamination may not always be serious in itself, it obscures the meaning of the bacteriological test when present.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) All new construction and repair work is disinfected with a chlorine solution containing not less than 50 p. p. m. of available chlorine: *Provided,* That where minor repairs are made to existing ground water supplies and adequate treatment of the water is provided beyond the point where repairs are made, disinfection shall not be mandatory.

(2) Not less than 5 p. p. m. of residual chlorine is present at the source and at other representative points which have been in contact

with the chlorine solution for a period of at least 3 hours, and preferably 10 hours or longer: *Provided*, That in the case of flowing springs and flowing wells this requirement shall not be mandatory. (See appendix B, Flowing Wells and Flowing Springs.)

(3) The system is thoroughly pumped or otherwise thoroughly flushed to remove all traces of chlorine after disinfection.

(4) The results of bacteriological examination of water samples collected after disinfection and flushing of newly developed ground water supplies show that all traces of contamination have been eliminated. Such tests shall be repeated at least once after the system is shown to be clean, to check on possible regrowths.

Refer to appendix B for recommended procedure for disinfection of springs and wells.

ITEM 28. BOTTLED WATERS

All bottled waters shall be so handled, from source to ultimate user, as to prevent contamination of such ground waters originally obtained from approved sources.

The provisions of this item shall not be interpreted as applying to carbonated waters, artificially prepared mineral waters, soft drinks, or similar beverages, but only to public ground water supplies, as defined in section 1, which are put into bottles or containers for the use of consumers: *Provided*, That the requirements of this item shall not be interpreted as replacing any provision of the Federal Food, Drug, and Cosmetic Act applying to beverages.

Public health reason.—Contamination of originally safe ground water supplies may occur in the processes of bottling, capping, handling, and reuse of containers. Therefore, special precautions should be taken to prevent such contamination.

Satisfactory compliance.—This item shall be deemed to have been satisfied when:

(1) Ground water sources used for bottling conform with the sanitation items for approved public ground water supplies given in this manual.

(2) Bottling is accomplished in a separate room equipped and used for this operation only.

(3) Bottling, capping, handling, and reuse of containers is carried out in such a manner that the final product ready for distribution in the container shall comply with the requirements of item 20 of this manual.

Specimens of bottled water collected for bacteriological analysis to determine compliance with this requirement should be taken at various places, including bottles in transit on delivery trucks, railroad cars, etc., to check on handling procedures and effectiveness of bottle washing.

APPENDIX A

Recommended Procedure for Cement Grouting of Wells for Sanitary Protection [1]

The annular space between the well casing and the well hole is one of the principal avenues through which undesirable water and pollutional matter may gain access to a well. The most satisfactory way of eliminating this hazard is to fill the annular space with cement grout. To accomplish this satisfactorily, careful attention should be given to see that:

(1) The grout mixture is properly prepared.

(2) The grout material is placed in one continuous mass.

(3) The grout material is placed upward from the bottom of the space to be grouted.

Concrete grout should be a mixture of cement, sand, and water in the proportion of 1 bag of cement (94 pounds), an equal volume of dry sand, and 5 to 6 gallons of clean water.

Neat cement grout should be a mixture of cement and water in the proportion of 1 bag of cement (94 pounds) and 5 to 6 gallons of clean water. Whenever possible, water content should be kept near the lower limit given. Hydrated lime to the extent of 10 percent of the volume of cement may be added to make the grout mix more fluid and thereby facilitate placement by the pumping equipment. Mixing of cement or cement and hydrated lime with the water must be thorough.

Grouting procedure.—The grout mixture must be placed in one continuous mass; hence, before starting the operation, sufficient materials should be on hand and other facilities available to accomplish the placement without interruption.

Restricted passages will result in clogging and failure to complete the grouting operation. The minimum clearance at any point, including couplings, should not be less than 1½ inches. When grouting through the annular space, the grout pipe should not be less than 1 inch nominal diameter. As the grout moves upward, it picks up much loose material such as results from caving. Accordingly, it is desirable to waste a suitable quantity of the grout which first emerges from the drill hole.

In grouting a well so that the material moves upward, there are two general procedures that may be followed: (1) The grout pipe may be installed within the well casing, or (2) in the annular space between the casing and drill hole, when there is sufficient clearance to permit this. In the latter case, the grout pipe is installed in the annular

[1] This information has been taken principally from a pamphlet of the Wisconsin State Board of Health entitled: "Methods of Cement Grouting for Sanitary Protection of Wells." The subject is discussed in greater detail in that publication.

space to within a few inches of the bottom of the annular space. The grout is pumped through this pipe, discharging into the annular space, and moving upward, around the casing pipe, finally overflowing at the ground surface. In 3 to 7 days the grout will be set, and the well can be completed and pumping started.

When the grout pipe is installed within the well casing, the casing should be supported a few inches above the bottom during grouting, to permit grout to flow into the annular space. The well casing is fitted at the bottom with a cap threaded to receive the grout pipe and a check valve to prevent return of grout into the casing pipe. After grout appears at the surface, the casing pipe is lowered to the bottom, grout pipe unscrewed immediately and raised a few inches. A suitable quantity of water should then be pumped through it, thereby flushing any remaining grout from it and the casing pipe. The grout pipe is then removed from the well, and 3 to 7 days are allowed for setting of the grout. The well is then cleared by drilling out the cap, check valve, plug, and grout remaining within the well.

A modification of this procedure is the use of the well casing itself to convey the grout to the annular space. The casing pipe is suspended in the drill hole and held several feet off the bottom. A "spacer" is inserted in the casing pipe. The casing pipe is then capped and connection made from it to the grout pump. The estimated quantity of grout, including a suitable allowance for filling of crevices and other voids, is then pumped into the casing pipe. The spacer moves before the grout, in turn forcing the water in the well ahead of it. Arriving at the lower casing terminal, the spacer is forced to the bottom of the drill hole, leaving sufficient clearance to permit flow of grout into the annular space and upward through it.

After the desired amount of grout has been pumped into the casing pipe, the cap is removed, and a second spacer is inserted in the casing pipe. The cap is then replaced and a measured volume of water, sufficient to fill all but a few feet of the casing pipe, is pumped into it. Thus all but a small quantity of the grout is forced from the casing pipe into the annular space. From 3 to 7 days are allowed for setting of the grout. The spacers and grout remaining in the casing and drill hole are then drilled out and the well completed.

When the annular space is to be grouted for only part of the total depth of the well, the grouting can be carried out as directed above when the well reaches the desired depth, and the well then continued below this level, within the first casing. In this type of construction, where various-sized casings "telescope" within each other, a seal should be placed at the point of transition or "telescoping" in the annular space between the two casing pipes of different diameters. The annular space for grouting between two metal casings should be not less than 1½ inches and the depth of the seal not less than 8 feet.

APPENDIX B

Recommended Procedure for Disinfection of Wells, Springs, and Appurtenances

An effective and economical method of disinfecting wells, springs, and appurtenances is by the use of calcium hypochlorite (chlorinated lime) containing approximately 25 percent available chlorine. This material can be purchased at most drug stores and in larger quantities at chemical supply houses; a fresh supply should be used, since the chemical deteriorates on exposure to the atmosphere. If commercial preparations of high-test calcium hypochlorite containing approximately 70 percent available chlorine are used, the required dosage will be about one-third the amount of chlorinated lime specified below.

To the amount of chlorinated lime specified in table 1, add small quantities of water slowly and stir until a smooth, watery paste free from lumps has been formed. Add from 5 to 20 gallons of water to the paste, and stir thoroughly from 10 to 15 minutes prior to allowing the solution to settle. The clearer liquid containing the chlorine should be used, and the inert material or lime that has settled to the bottom of the container discarded. The solution should be prepared in a thoroughly cleaned utensil; the use of metal containers should be avoided, if possible, since they are corroded by strong chlorine solutions.

Where small quantities of chlorinated lime are required and a scale is not available, the material can be measured with a spoon. A moderately heaping tablespoonful of chlorinated lime, that is, with the powder about 1 inch deep in the center, weighs approximately 1 ounce.

TABLE 1.—*Liquid capacity of wells or spring structures and the amounts of chlorinated lime required to provide a dosage of approximately 50 parts per million of available chlorine*

Capacity of well or spring in gallons	Chlorinated lime required, in ounces	Approximate volume of water, in gallons, to be used in preparing chlorine solution
50	1.5	5
100	3.0	5
200	6.0	5
300	9.0	5
400	12.0	5
500	15.0	5
1,000	30.0	10
2,000	60.0	15
3,000	90.0	20

Spring basins.—(1) Wash the interior walls of the spring basin with a solution of chlorinated lime, using a stiff broom or brush to assure thorough cleaning, prior to placing the cover over the structure.

(2) Where a manhole opening is not provided in the cover, the proper amount of chlorinated lime solution should be poured into the basin and mixed with the water just before placing the cover over the structure. Care should be taken in placing the cover in position to prevent any extraneous material from entering the basin.

(3) Where a manhole is provided in the cover of the spring basin, the proper amount of chlorinated lime should be poured into the basin through the manhole opening and mixed with the water just before placing the cover over the manhole.

Shallow wells.—(1) After the casing or lining is completed, proceed as outlined below before the cover platform is placed over the well.

(*a*) Remove all equipment and materials including tools, forms, platforms, etc., which will not form a permanent part of the completed structure.

(*b*) Wash the interior walls of the casing or lining with a solution of chlorinated lime, using a stiff broom or brush to assure thorough cleaning.

(*c*) Pump the water from the well until it is perfectly clear, and remove the pumping equipment that was temporarily set up for this purpose.

(2) Place the cover over the well, and pour the required amount of chlorinated lime solution into the well through the manhole or pipe sleeve opening just prior to inserting the pump cylinder and drop pipe assembly. Care should be taken to distribute the chlorine solution over as much of the surface of the water as possible to obtain proper diffusion of the chemical with the well water.

(3) Wash the exterior surface of the pump cylinder and drop pipe with the chlorinated lime solution as the assembly is being lowered into the well.

(4) After the pump has been set in position, pump water from the well until a strong odor of chlorine is noted.

(5) Allow the chlorine solution to remain in the well for not less than 10 hours.

(6) After not less than 10 hours has elapsed, the well should be flushed by pumping the water to waste to remove all traces of chlorine.

Drilled and bored wells, flowing wells, and flowing springs.—(1) When the well is being tested for yield, the test pump should be operated until the well water is as clear and free from turbidity as possible.

(2) After the testing equipment has been removed, pour the required amount of chlorinated lime solution into the well slowly just prior to installing the permanent pumping equipment. Diffusion of the chemical with the well water may be facilitated by running the solution into the well through a hose or pipe line as the line is being alternately raised and lowered, and this method should be followed whenever possible.

(3) Wash the exterior surfaces of the pump cylinder and drop pipe with a chlorinated lime solution as the assembly is being lowered into the well.

(4) After the pump has been set in position, operate the pump until water discharged to waste has a distinct odor of chlorine. Repeat this procedure a few times after intervals of about 1 hour.

(5) When the chlorine solution has been completely circulated through the column of water in the well and the pumping equipment, allow the chlorine solution to remain in the well for not less than 10 hours.

(6) After not less than 10 hours have elapsed, the well should be flushed by pumping the water to waste to remove all traces of chlorine. The pump should be operated until water discharged to waste is free from the odor of chlorine.

In the case of deep wells having a high water level, it may be necessary to resort to special methods of introducing the disinfecting agent into the well so as to insure proper diffusion of chlorine throughout the well. A method readily available is to place chlorinated lime or high test granulated calcium hypochlorite in a short section of pipe capped at both ends. A number of small holes should be drilled through each cap and one of the caps fitted with an eye to facilitate attachment of a suitable cable. The disinfecting agent is distributed by lowering and raising the pipe section throughout the depth of the water. In the case of flowing wells and flowing springs, the pipe section should be moved up and down near the bottom of the well or spring. The water moving upward through the well or spring will carry with it the disinfecting agent released at the bottom. It is impractical to maintain chlorine in flowing wells and springs for 10 hours as specified in paragraph (5) above. Sufficient chlorine, therefore, should be applied to maintain a chlorine residual of 50 p. p. m. in the water flowing from the well or spring for at least 20 minutes. If bacteriological results on water samples collected after all traces of chlorine have disappeared indicate that the water is not safe to use, the disinfection procedure should be repeated until satisfactory results are obtained or else the supply should be chlorinated continuously or abandoned.

Sometimes an existing well is encountered which does not respond to the usual methods of sterilization. Usually a well like this has been polluted by water which entered the well under sufficient head to cause a flow of water from the well into the water-bearing formation, carrying the pollution with it. To reach the bacteria which have thus been carried into the water-bearing formation, it is necessary to force chlorine into the formation. This may be done in a number of ways, depending on the construction of the well. In some wells, it is advisable to chlorinate the water in the well and then add a consider-

able volume of chlorinated water in order to force the treated water into the formation. In other wells, such as the drilled well cased with standard weight casing pipe, it is entirely practicable to chlorinate the water in the well, then cap the well and apply a head of air. By alternately applying and releasing the air, a vigorous surging effect is obtained, and chlorinated water is forced into the water-bearing formation. After treating a well in this manner it is necessary, of course, to flush it to remove the chlorine.

Should the reports on the bacteriological examination of water samples be unsatisfactory after disinfection, it would indicate that the initial treatment was ineffective. In this case, the procedure should be repeated until tests show that water samples from that portion of the system being disinfected are satisfactory from a bacteriological standpoint.

The water from the system should not be used for domestic and culinary purposes until the report on the bacteriological examination of water samples indicates that the water is safe for domestic use.

DEATHS DURING WEEK ENDED JANUARY 22, 1944

[From the Weekly Mortality Index, issued by the Bureau of the Census, Department of Commerce]

	Week ended Jan. 22, 1944	Corresponding week, 1943
Data for 90 large cities of the United States:		
Total deaths	10,359	10,066
Average for 3 prior years	9,995	
Total deaths, first 3 weeks of year	35,219	31,083
Deaths under 1 year of age	579	713
Average for 3 prior years	604	
Deaths under 1 year of age, first 3 weeks of year	1,952	2,252
Data from industrial insurance companies:		
Policies in force	66,222,332	65,281,877
Number of death claims	19,037	14,910
Death claims per 1,000 policies in force, annual rate	15.0	11.9
Death claims per 1,000 policies, first 3 weeks of year, annual rate	12.9	11.2

PREVALENCE OF DISEASE

No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring

UNITED STATES

REPORTS FROM STATES FOR WEEK ENDED JANUARY 29, 1944

Summary

The incidence of influenza declined for the third consecutive week. A total of 22,483 cases was reported, or less than half the number (47,143) reported for the preceding week. The comparable 5-year (1939–43) median is 4,899. The largest comparable weekly figure during that period was 91,203 cases, reported in 1941. Declines occurred during the current week in all geographic areas of the country. States reporting more than 1,000 cases, all showing sharp declines, are as follows: Virginia, 2,404, North Carolina 1,878, Alabama 1,264, Louisiana 1,990, Texas 5,990, and Utah 1,115. The cumulative total for the first 4 weeks of the year is 261,981, as compared with the 5-year median of 17,421 and 371,988 for the corresponding period in 1941.

The incidence of meningococcus meningitis continues at a high level. A total of 527 cases was reported for the current week, as compared with 522 last week, 399 for the corresponding week last year, and 55 for the 5-year median. Of the current total, 437 cases occurred in 19 States which reported 10 or more cases each. An aggregate of 313 cases was reported in 9 States which recorded more than 16 cases each as follows (last week's figures in parentheses): *Increases*—New Jersey 25 (12), Michigan 29 (27), Missouri 34 (12), Tennessee 37 (20), California 39 (31); *decreases*—New York 56 (68), Ohio 24 (31), Texas 28 (30); *no change*—Pennsylvania 41.

The incidence of scarlet fever and measles is above that for both last year and the 5-year medians. During the current week, 4,936 cases of scarlet fever and 15,403 cases of measles were reported, representing an incidence 32 percent and 42 percent, respectively, above the 5-year medians. The higher incidence of scarlet fever than last year is reported for all geographic areas except the New England and West South Central. Approximately three times as many cases were

reported currently in the Pacific States as for the corresponding week last year. A total of 17,066 cases of scarlet fever has been reported to date as compared with 14,150 for the same period last year, and 49,851 cases of measles as compared with 36,101 last year. Typhoid fever is slightly above both last year's incidence and the 5-year median. Of 79 cases reported currently, 32 cases occurred in Indiana.

The total numbers of reported cases of diphtheria, poliomyelitis, smallpox, and whooping cough, both currently and for the first 4 weeks of the year, are below the respective corresponding 5-year medians.

Deaths registered in 90 large cities of the United States for the current week totaled 9,954, as compared with 10,359 for the preceding week and a 3-year (1941–43) average of 9,786. The total for the first 4 weeks of the year is 45,173, as compared with 41,264 for the same period of 1943.

Telegraphic morbidity reports from State health officers for the week ended January 29, 1944, and comparison with corresponding week of 1943 and 5-year median

In these tables a zero indicates a definite report, while leaders imply that, although none was reported, cases may have occurred.

Division and State	Diphtheria			Influenza			Measles			Meningitis, meningococcus		
	Week ended		Median 1939–43	Week ended		Median 1939–43	Week ended		Median 1939–43	Week ended		Median 1939–43
	Jan. 29, 1944	Jan. 30, 1943		Jan. 29, 1944	Jan. 30, 1943		Jan. 29, 1944	Jan. 30, 1943		Jan. 29, 1944	Jan. 30, 1943	
NEW ENGLAND												
Maine	0	0	0	41	-----	10	227	6	34	3	12	0
New Hampshire	0	0	0	-----	-----	-----	9	34	6	1	2	0
Vermont	1	0	0	19	-----	-----	19	324	22	0	0	0
Massachusetts	7	2	4	-----	-----	-----	377	496	341	16	10	2
Rhode Island	0	0	0	24	-----	-----	279	22	22	5	23	1
Connecticut	3	0	1	53	14	4	185	372	164	8	3	1
MIDDLE ATLANTIC												
New York	8	12	24	[1] 15	[1] 14	[1] 16	928	1,395	1,214	56	29	4
New Jersey	4	1	8	24	24	24	913	431	28	25	13	1
Pennsylvania	8	8	13	20	2	-----	1,272	2,458	1,137	41	15	7
EAST NORTH CENTRAL												
Ohio	7	12	12	72	9	15	2,314	111	111	24	5	2
Indiana	7	8	14	134	6	25	267	192	61	6	8	1
Illinois	15	14	25	68	4	30	436	273	120	16	7	0
Michigan [2]	6	6	6	32	1	2	1,132	135	354	29	6	1
Wisconsin	1	6	5	601	93	64	1,099	449	286	12	13	1
WEST NORTH CENTRAL												
Minnesota	7	5	3	-----	2	3	710	19	235	2	2	0
Iowa	5	3	3	251	-----	6	246	86	109	1	0	0
Missouri	3	6	5	5	6	26	99	96	26	34	14	2
North Dakota	1	1	2	14	23	23	275	42	42	1	0	0
South Dakota	0	6	5	-----	-----	2	158	154	39	0	1	0
Nebraska	5	0	2	3	18	1	19	201	32	1	1	0
Kansas	7	5	5	54	10	10	153	101	213	9	6	0
SOUTH ATLANTIC												
Delaware	2	0	1	-----	-----	-----	10	12	1	2	1	0
Maryland [2]	10	9	6	267	13	13	217	32	32	7	20	1
District of Columbia	3	1	1	5	4	4	60	51	11	3	4	1
Virginia	8	5	10	2,404	567	617	270	122	135	15	18	5
West Virginia	2	8	8	354	15	41	200	4	11	2	0	1
North Carolina	11	11	18	45	12	66	460	14	87	11	8	2
South Carolina	8	4	8	1,878	678	678	144	7	11	9	11	1
Georgia	7	7	7	408	154	183	284	27	39	8	5	0
Florida	2	11	6	76	7	10	95	11	33	11	1	1
EAST SOUTH CENTRAL												
Kentucky	8	4	8	845	19	27	[3]97	226	48	12	5	2
Tennessee	7	1	3	419	105	109	357	133	48	37	2	2
Alabama	6	13	12	1,264	379	644	349	11	62	10	7	3
Mississippi [2]	7	11	7	-----	-----	-----	-----	-----	-----	11	8	1
WEST SOUTH CENTRAL												
Arkansas	9	5	8	862	150	267	42	120	63	3	2	1
Louisiana	5	8	8	1,990	7	26	32	69	39	10	7	1
Oklahoma	2	12	11	661	141	193	0	11	11	3	0	1
Texas	30	70	53	5,990	1,900	1,900	340	147	147	28	12	3
MOUNTAIN												
Montana	1	2	2	517	25	25	246	84	77	3	0	0
Idaho	0	0	0	-----	-----	1	27	97	64	0	1	0
Wyoming	0	0	1	205	43	37	51	21	20	0	0	0
Colorado	8	9	9	298	113	50	226	230	57	3	3	0
New Mexico	3	3	2	32	4	10	6	21	29	0	1	0
Arizona	4	3	3	543	155	155	112	15	15	2	1	1
Utah [2]	0	1	0	1,115	9	15	5	516	40	0	4	0
Nevada	1	0	0	10	1	-----	1	8	0	0	0	0
PACIFIC												
Washington	6	9	2	3	1	13	88	810	113	5	13	0
Oregon	8	4	2	157	35	53	68	448	147	3	7	1
California	41	35	24	705	89	155	499	243	389	39	28	2
Total	294	341	354	22,483	4,852	4,899	15,403	10,887	10,844	527	339	55
4 weeks	1,059	1,355	1,481	261,981	17,421	17,421	[3]49,851	36,101	36,328	2,274	1,282	210

See footnotes at end of table.

Telegraphic morbidity reports from State health officers for the week ended January 29, 1944, and comparison with corresponding week of 1943 and 5-year median—Con.

Division and State	Poliomyelitis			Scarlet fever			Smallpox			Typhoid and paratyphoid fever [4]		
	Week ended		Median 1939–43	Week ended		Median 1939–43	Week ended		Median 1939–43	Week ended		Median 1939–43
	Jan. 29, 1944	Jan. 30, 1943		Jan. 29, 1944	Jan. 30, 1943		Jan. 29, 1944	Jan. 30, 1943		Jan. 29, 1944	Jan. 30, 1943	
NEW ENGLAND												
Maine	0	1	0	33	8	13	0	0	0	2	0	1
New Hampshire	0	0	0	14	11	8	0	0	0	0	1	0
Vermont	0	0	0	11	4	6	0	0	0	0	0	0
Massachusetts	0	3	0	314	416	194	0	0	0	0	2	2
Rhode Island	0	0	0	13	29	10	0	0	0	0	0	0
Connecticut	0	0	0	86	65	65	0	0	0	0	2	1
MIDDLE ATLANTIC												
New York	0	1	1	391	416	440	0	0	0	3	3	3
New Jersey	0	0	0	142	88	177	0	0	0	1	1	0
Pennsylvania	0	0	0	341	0	348	0	0	0	3	5	6
EAST NORTH CENTRAL												
Ohio	0	1	1	314	318	339	2	2	1	8	0	1
Indiana	3	0	0	90	126	157	0	12	7	32	2	2
Illinois	2	0	1	257	201	410	0	0	0	1	1	1
Michigan [3]	0	0	0	236	100	207	0	1	1	0	2	2
Wisconsin	0	0	0	303	264	214	0	1	2	0	1	1
WEST NORTH CENTRAL												
Minnesota	0	1	0	157	67	93	0	0	3	0	0	1
Iowa	0	0	0	96	63	63	1	1	7	1	0	1
Missouri	0	0	0	93	110	91	0	0	2	0	0	1
North Dakota	0	0	0	13	16	19	0	0	0	0	0	0
South Dakota	0	0	0	42	38	29	0	0	0	0	0	0
Nebraska	0	0	0	74	23	34	0	0	0	0	0	0
Kansas	1	0	0	87	58	90	1	0	1	0	0	0
SOUTH ATLANTIC												
Delaware	0	0	0	8	6	13	0	0	0	0	0	0
Maryland [3]	1	0	0	113	81	75	0	0	0	1	1	2
District of Columbia	0	0	0	131	29	13	0	0	0	0	1	0
Virginia	0	0	0	74	45	50	2	0	0	1	5	3
West Virginia	0	0	0	48	27	56	0	0	0	0	0	0
North Carolina	0	1	1	56	63	58	0	0	0	0	1	0
South Carolina	0	0	1	10	12	7	0	0	0	1	0	1
Georgia	0	0	0	23	33	25	0	1	1	4	2	3
Florida	0	1	1	25	11	7	0	0	0	4	0	0
EAST SOUTH CENTRAL												
Kentucky	0	2	1	64	50	66	0	0	0	0	0	0
Tennessee	3	0	0	41	43	54	0	0	1	3	2	2
Alabama	0	1	1	12	16	16	2	2	0	1	0	2
Mississippi [3]	0	0	0	15	11	8	1	0	1	0	1	1
WEST SOUTH CENTRAL												
Arkansas	0	1	0	4	7	8	0	2	1	0	2	2
Louisiana	0	1	1	8	10	10	0	0	0	4	4	4
Oklahoma	0	0	0	5	29	29	0	0	0	0	1	1
Texas	4	5	1	65	56	64	1	0	5	3	2	4
MOUNTAIN												
Montana	0	0	0	53	9	24	0	0	0	0	0	0
Idaho	0	0	0	37	3	4	0	0	0	0	0	0
Wyoming	0	0	0	14	53	12	0	0	0	0	0	0
Colorado	2	1	0	68	79	41	0	0	4	0	1	1
New Mexico	0	0	0	6	7	9	0	1	1	2	0	1
Arizona	0	0	0	14	5	5	0	0	0	0	0	0
Utah [3]	0	0	0	199	59	25	0	0	0	0	0	0
Nevada	0	0	0	1	0	0	0	0	0	0	0	0
PACIFIC												
Washington	2	1	1	238	25	29	1	0	0	0	1	1
Oregon	0	1	0	78	20	20	0	0	0	2	0	0
California	11	9	2	419	191	191	1	1	2	2	2	2
Total	29	31	31	4,936	3,401	3,746	12	24	47	79	46	72
4 weeks	119	136	136	17,066	14,150	14,150	49	127	189	253	201	315

See footnotes at end of table

Telegraphic morbidity reports from State health officers for the week ended January 29, 1944, and comparison with corresponding week of 1943 and 5-year median—Con.

Division and State	Whooping cough			Week ended Jan. 29, 1944								
	Week ended		Median 1939–43	Anthrax	Dysentery			Encephalitis, infectious	Leprosy	Rocky Mt. spotted fever	Tularemia	Typhus fever
	Jan. 29, 1944	Jan. 30, 1943			Amebic	Bacillary	Unspecified					
NEW ENGLAND												
Maine	6	81	47	0	0	0	0	0	0	0	0	0
New Hampshire	9	18	7	0	0	0	0	0	0	0	0	0
Vermont	10	34	57	0	0	0	0	0	0	0	0	0
Massachusetts	99	173	189	0	0	1	0	0	0	0	1	0
Rhode Island	2	24	24	0	0	0	0	0	0	0	0	0
Connecticut	17	71	89	0	0	2	0	0	0	0	0	0
MIDDLE ATLANTIC												
New York	166	388	405	0	4	11	0	0	0	0	0	0
New Jersey	56	150	150	0	5	0	0	0	0	0	0	0
Pennsylvania	114	379	379	0	0	0	0	0	0	0	0	0
EAST NORTH CENTRAL												
Ohio	114	277	277	0	0	0	0	0	0	0	0	0
Indiana	20	22	22	0	0	2	0	0	0	0	1	0
Illinois	91	188	188	0	0	0	0	1	0	0	0	0
Michigan [1]	142	326	262	0	0	0	0	0	0	0	0	0
Wisconsin	97	210	210	0	0	0	0	0	0	0	0	0
WEST NORTH CENTRAL												
Minnesota	37	74	52	0	0	0	0	0	0	0	0	0
Iowa	14	18	18	0	0	0	0	0	0	0	0	0
Missouri	14	28	23	0	0	0	0	0	0	0	0	0
North Dakota	4	11	11	0	0	0	0	0	0	0	0	0
South Dakota	5	0	3	0	0	0	0	0	0	0	0	0
Nebraska	0	3	3	0	0	0	0	0	0	0	0	0
Kansas	36	43	43	0	1	0	0	1	0	0	0	0
SOUTH ATLANTIC												
Delaware	0	7	7	0	0	0	0	0	0	0	0	0
Maryland [2]	29	73	73	0	0	0	0	0	0	0	0	0
District of Columbia	5	10	10	0	0	0	0	0	0	0	0	0
Virginia	58	56	74	0	0	0	35	0	0	0	0	1
West Virginia	30	61	49	0	0	0	0	0	0	0	0	0
North Carolina	162	99	218	0	0	0	0	0	0	0	0	3
South Carolina	72	31	66	0	0	2	0	0	0	0	0	1
Georgia	14	27	27	0	0	0	0	0	0	0	3	16
Florida	16	26	11	0	2	0	0	0	0	0	0	1
EAST SOUTH CENTRAL												
Kentucky	84	50	50	0	1	1	0	0	0	0	0	0
Tennessee	31	53	22	0	0	0	1	0	0	0	3	2
Alabama	12	41	26	0	0	0	0	1	0	0	0	5
Mississippi [3]				0	0	0	0	0	0	0	0	0
WEST SOUTH CENTRAL												
Arkansas	17	35	17	0	1	6	0	0	0	0	0	0
Louisiana	16	10	5	0	1	1	0	1	1	0	1	0
Oklahoma	1	7	7	0	0	0	0	0	0	0	0	0
Texas	133	295	139	0	2	177	0	0	0	0	2	14
MOUNTAIN												
Montana	19	45	14	0	0	0	0	0	0	0	0	0
Idaho	5	2	6	0	0	0	0	0	0	0	0	0
Wyoming	13	4	4	0	0	0	0	0	0	0	0	0
Colorado	38	22	32	0	0	0	0	0	0	0	0	0
New Mexico	3	24	39	0	0	0	0	0	0	0	0	0
Arizona	31	14	12	0	0	0	19	0	0	0	0	0
Utah [2]	13	32	37	0	0	0	0	0	0	0	0	0
Nevada	0	0	0	0	0	0	0	0	0	0	0	0
PACIFIC												
Washington	49	28	29	0	0	0	0	0	0	0	0	0
Oregon	34	10	16	0	0	0	0	0	0	0	0	0
California	80	266	202	0	1	2	0	0	0	0	1	0
Total	2,018	3,846	4,237	0	18	205	55	4	1	0	12	43
4 weeks	7,069	15,883	17,010	3	99	1,015	214	34	3	0	54	199
4 weeks, 1943				7	74	571	151	35	4	1	89	262

[1] New York City only.
[2] Period ended earlier than Saturday.
[3] Later information shows 152 cases of measles in Kentucky for the week ended Jan. 15, 1944, instead of 18 as previously reported.
[4] Including paratyphoid fever cases reported separately as follows: South Carolina, 1; Georgia, 1; Florida, 3.

WEEKLY REPORTS FROM CITIES

City reports for week ended January 15, 1944

This table lists the reports from 86 cities of more than 10,000 population distributed throughout the United States, and represents a cross section of the current urban incidence of the diseases included in the table.

	Diphtheria cases	Encephalitis, infectious, cases	Influenza		Measles cases	Meningitis, meningococcus, cases	Pneumonia deaths	Poliomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
NEW ENGLAND												
Maine:												
Portland	0	0	-----	0	10	1	7	0	7	0	0	3
New Hampshire:												
Concord	0	0	-----	1	1	0	2	0	0	0	0	0
Vermont:												
Barre	0	0	-----	0	0	0	0	0	0	0	0	0
Massachusetts:												
Boston	4	0	-----	1	30	20	40	0	70	0	0	24
Fall River	0	0	-----	0	0	0	1	0	6	0	0	2
Springfield	0	0	-----	0	34	0	1	0	11	0	0	8
Worcester	0	0	-----	2	7	3	19	0	50	0	0	3
Rhode Island:												
Providence	1	0	-----	3	131	2	14	0	3	0	1	1
Connecticut:												
Bridgeport	0	0	33	1	0	2	0	0	2	0	0	2
Hartford	3	0	-----	1	1	4	5	0	2	0	0	1
New Haven	0	0	-----	1	4	1	3	0	6	0	0	0
MIDDLE ATLANTIC												
New York:												
Buffalo	0	0	-----	2	6	2	12	0	6	0	1	0
New York	7	1	28	11	545	72	123	0	202	0	1	31
Rochester	0	0	-----	0	0	1	15	0	4	0	0	9
Syracuse	2	0	-----	1	0	1	5	0	8	0	0	17
New Jersey:												
Camden	0	0	2	2	1	0	4	0	7	0	0	0
Newark	0	0	8	1	32	3	10	0	12	0	0	10
Trenton	0	1	6	3	1	1	1	0	7	0	0	0
Pennsylvania:												
Philadelphia	2	1	38	16	6	16	59	0	35	0	0	7
Pittsburgh	0	0	28	15	280	6	36	0	19	0	1	9
Reading	0	0	1	4	1	1	0	0	3	0	0	1
EAST NORTH CENTRAL												
Ohio:												
Cincinnati	3	0	4	8	13	5	0	0	37	0	0	5
Cleveland	0	0	15	2	250	5	22	0	66	0	1	19
Columbus	0	0	6	6	19	0	11	0	10	0	0	3
Indiana:												
Fort Wayne	0	0	-----	1	22	0	5	0	0	0	0	0
Indianapolis	4	0	-----	1	1	3	20	0	28	0	0	14
South Bend	0	0	-----	0	25	0	0	0	1	0	0	0
Terre Haute	0	0	-----	1	0	0	1	0	0	0	0	0
Illinois:												
Chicago	1	0	7	5	29	12	40	0	91	0	1	27
Springfield	0	0	-----	0	18	0	5	0	3	0	0	0
Michigan:												
Detroit	3	0	15	3	27	9	32	0	44	0	1	19
Flint	0	0	-----	0	0	1	0	0	2	0	0	0
Grand Rapids	0	0	-----	2	80	3	5	0	7	0	0	0
Wisconsin:												
Kenosha	0	0	-----	1	0	0	0	0	8	0	0	4
Milwaukee	0	0	1	1	12	3	5	0	47	0	0	26
Racine	0	0	1	1	1	0	0	0	11	0	0	2
Superior	0	0	-----	0	53	2	3	0	2	0	0	1
WEST NORTH CENTRAL												
Minnesota:												
Duluth	0	0	-----	1	6	0	1	0	17	0	0	13
Minneapolis	0	0	-----	1	161	2	5	0	27	0	0	6
St. Paul	2	0	-----	1	48	4	9	0	23	0	0	8
Missouri:												
Kansas City	0	0	-----	6	2	3	19	0	18	0	1	5
St. Joseph	0	0	-----	0	0	0	0	0	1	1	0	0
St. Louis	0	0	20	4	25	15	26	1	14	0	0	4

City reports for week ended January 15, 1944—Continued

	Diphtheria cases	Encephalitis, infectious, cases	Influenza		Measles cases	Meningitis, meningococcus, cases	Pneumonia deaths	Poliomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
WEST NORTH CENTRAL—continued												N
North Dakota:												
Fargo	0	0	-----	1	66	0	3	0	2	1	0	0
Nebraska:												
Omaha	1	0	-----	2	1	0	14	0	11	0	0	0
Kansas:												
Topeka	0	0	-----	0	0	1	2	0	2	0	0	5
Wichita	0	0	4	1	38	0	11	0	3	0	0	0
SOUTH ATLANTIC												
Delaware:												
Wilmington	1	0	-----	0	5	1	2	0	0	0	0	0
Maryland:												
Baltimore	2	0	13	8	66	4	25	0	34	0	0	13
Cumberland	0	0	2	0	0	0	1	0	0	0	0	0
Frederick	0	0	-----	0	0	0	2	0	0	0	0	0
District of Columbia:												
Washington	0	0	62	2	31	1	24	0	60	0	0	6
Virginia:												
Lynchburg	0	0	70	0	33	1	3	0	1	0	0	0
Richmond	0	0	7	5	8	5	4	1	6	0	0	1
Roanoke	0	0	-----	0	7	0	2	0	0	0	0	1
West Virginia:												
Charleston	0	0	-----	0	0	0	0	0	2	0	0	0
Wheeling	0	0	5	0	0	0	3	0	2	0	0	2
North Carolina:												
Wilmington	0	0	4	0	4	0	1	0	0	0	0	0
Winston-Salem	0	0	-----	0	57	0	0	0	0	0	0	2
South Carolina:												
Charleston	0	0	366	2	6	1	2	0	3	0	0	1
Georgia:												
Atlanta	1	0	234	6	0	2	6	0	4	0	0	1
Brunswick	0	0	-----	0	56	1	0	0	2	0	0	0
Savannah	0	0	60	9	0	1	4	0	0	0	0	0
EAST SOUTH CENTRAL												
Tennessee:												
Memphis	0	0	22	2	3	3	5	0	8	0	0	3
Nashville	0	0	-----	11	2	4	8	0	3	0	0	0
Alabama:												
Birmingham	0	0	415	5	18	1	12	0	4	0	0	1
Mobile	0	1	998	5	1	1	6	0	0	0	0	0
WEST SOUTH CENTRAL												
Arkansas:												
Little Rock	0	0	89	1	5	0	2	0	0	0	0	2
Louisiana:												
New Orleans	0	0	169	11	10	2	16	0	2	0	1	1
Shreveport	0	0	-----	10	0	0	4	0	2	0	1	0
Texas:												
Dallas	1	0	5	5	2	1	12	0	1	0	0	0
Houston	1	0	-----	3	0	0	9	0	1	0	0	0
San Antonio	0	0	11	8	3	0	25	0	0	0	0	0
MOUNTAIN												
Montana:												
Billings	0	0	-----	0	2	0	0	0	1	0	0	0
Great Falls	0	0	181	1	18	0	0	0	5	0	0	0
Helena	0	0	-----	0	2	1	3	0	2	0	0	0
Missoula	0	0	150	0	0	0	6	0	1	0	0	0
Idaho:												
Boise	0	0	77	0	0	0	0	0	0	0	0	1
Colorado:												
Denver	5	0	22	1	12	1	11	0	12	0	0	19
Pueblo	0	0	-----	0	80	0	4		1	0	0	2

City reports for week ended January 15, 1944—Continued

	Diphtheria cases	Encephalitis, infectious, cases	Influenza		Measles cases	Meningitis, meningococcus, cases	Pneumonia deaths	Poliomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
PACIFIC												
Washington:												
Seattle	1	0	-----	6	0	0	9	0	8	0	0	11
Spokane	0	0	7	6	24	0	5	0	21	0	0	3
Tacoma	0	0	-----	3	4	1	3	0	75	0	0	2
California:												
Los Angeles	5	0	174	10	30	3	18	1	27	0	1	5
Sacramento	1	0	16	3	3	0	3	0	1	0	0	0
San Francisco	2	0	188	3	2	3	14	0	25	0	0	4
Total	53	4	3,564	240	2,481	242	850	3	1,251	2	11	370
Corresponding week, 1943	76	2	308	50	2,055	88	605	7	1,252	1	6	1,201
Average, 1939–43	99	-----	1,918	[1] 78	[2] 2,201	-----	[1] 563	-----	1,130	11	15	1,097

Anthrax.—Cases: San Francisco, 1.
Dysentery, amebic.—Cases: New York, 2; San Francisco, 1.
Dysentery, bacillary.—Cases: New York, 17; Chicago, 1; Charleston, S. C., 1; Memphis, 1; Los Angeles, 8.
Dysentery, unspecified.—Cases: Richmond, 1; San Antonio, 1.
Tularemia.—Cases: Lynchburg, 1; Nashville, 1.
Typhus fever.—Cases: Charleston, S. C., 1; Savannah, 2; Birmingham, 1; New Orleans, 1; San Antonio, 1; Los Angeles, 1.

[1] 3-year average, 1941–43.
[2] 5-year median.

Rates (annual basis) per 100,000 population, by geographic groups, for the 86 cities in the preceding table (estimated population, 1942, 34,391,800)

	Diphtheria case rates	Encephalitis, infectious, case rates	Influenza		Measles case rates	Meningitis, meningococcus, case rates	Pneumonia death rates	Poliomyelitis case rates	Scarlet fever case rates	Smallpox case rates	Typhoid and paratyphoid fever case rates	Whooping cough case rates
			Case rates	Death rates								
New England	19.9	0.0	82	24.9	543	82.2	229.2	0.0	391	0.0	2.5	110
Middle Atlantic	4.9	1.3	50	24.6	390	46.1	118.5	0.0	136	0.0	1.3	38
East North Central	6.4	0.0	29	18.7	322	25.2	87.2	0.0	209	0.0	1.8	70
West North Central	5.9	0.0	47	33.3	680	49.0	176.4	2.0	231	3.9	2.0	80
South Atlantic	7.1	0.0	1,465	57.0	486	30.3	140.6	1.8	203	0.0	0.0	48
East South Central	0.0	6.0	8,547	137.0	143	53.6	184.6	0.0	89	0.0	0.0	24
West South Central	6.1	0.0	837	116.1	61	9.2	207.7	0.0	18	0.0	6.1	9
Mountain	53.0	0.0	4,556	21.2	1,208	21.2	254.3	0.0	233	0.0	0.0	233
Pacific	15.7	0.0	675	54.3	110	12.3	91.1	1.8	275	0.0	1.8	44
Total	8.1	0.6	542	36.5	377	36.8	129.2	0.5	190	0.3	1.7	56

FOREIGN REPORTS

CANADA

Provinces—Communicable diseases—Week ended January 1, 1944.—During the week ended January 1, 1944, cases of certain communicable diseases were reported by the Dominion Bureau of Statistics of Canada as follows:

Disease	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Total
Chickenpox		4		22	320	77	101	69	135	728
Diphtheria		11	4	9	2	11	2	1		40
Dysentery (bacillary)				2						2
German measles		1		3	9		5	2	3	23
Influenza		523	270		920	45			1,550	3,308
Measles		8		15	97	18	20	60	17	235
Meningitis, meningococcus		1			7	1			2	11
Mumps		6			150	52	7	14	38	267
Scarlet fever		6	6	17	133	56	25	30	42	315
Tuberculosis (all forms)		2	8	3	49	10	5	16	73	166
Typhoid and paratyphoid fever		3		4	1	1			1	10
Undulant fever						1				1
Whooping cough		12		8	73	6	18	2	10	129

CUBA

Habana—Communicable diseases—4 weeks ended January 8, 1944.—During the 4 weeks ended January 8, 1944, certain communicable diseases were reported in Habana, Cuba, as follows:

Disease	Cases	Deaths	Disease	Cases	Deaths
Diphtheria	34		Scarlet fever	1	
Malaria	8		Tuberculosis	4	3
Measles	22		Typhoid fever	26	4

GERMANY

Vital statistics—First 9 months of 1943.—During the first 9 months of 1943, a total of 995,774 births was reported in greater Germany which was an increase of 42,000 births over the corresponding period of 1942.

The number of deaths reported for the same period amounted to 715,257 excluding deaths in the army and civilians killed by enemy action. The death rate per 1,000 is 11.8 as compared with 12.3 for the same period of 1942.

REPORTS OF CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER RECEIVED DURING THE CURRENT WEEK

NOTE.—Except in cases of unusual prevalence, only those places are included which had not previously reported any of the above-named diseases, except yellow fever, during the current year. All reports of yellow fever are published currently.

A cumulative table showing the reported prevalence of these diseases for the year to date is published in the PUBLIC HEALTH REPORTS for the last Friday of each month.

(Few reports are available from the invaded countries of Europe and other nations in war zones.)

Smallpox

Algeria.—For the period December 1–10, 1943, 122 cases of smallpox were reported in Algeria.

Indochina.—For the period December 1–20, 1943, 204 cases of smallpox were reported in Indochina.

Mexico—Torreon.—Smallpox has been reported in Torreon, Mexico, as follows: Week ended January 8, 1944, 9 cases; week ended January 15, 1944, 10 cases. Precautionary measures are being taken.

Typhus Fever

Algeria.—For the period December 1–10, 1943, 33 cases of typhus fever were reported in Algeria.

Curaçao.—During the week ended January 8, 1944, 1 case of typhus fever was reported in Curaçao.

Hungary.—During the week ended December 4, 1943, 19 cases of typhus fever were reported in Hungary.

Rumania.—For the period December 16, 1943, to January 7, 1944, 690 cases of typhus fever were reported in Rumania.

Spain.—During the week ended November 27, 1943, 19 cases of typhus fever were reported in Spain.

Yellow Fever

Cape Verde Islands—Praia.—On January 18, 1944, 1 case of suspected yellow fever was reported in Praia, Cape Verde Islands.

On vessel—At Lisbon.—According to information dated January 21, 1944, it is reported that a vessel which called at the islands of São Tomé and Cape Verde has arrived at Lisbon, Portugal, with cases of yellow fever on board. São Tomé is a small island near the Equator and west of French Equatorial Africa.