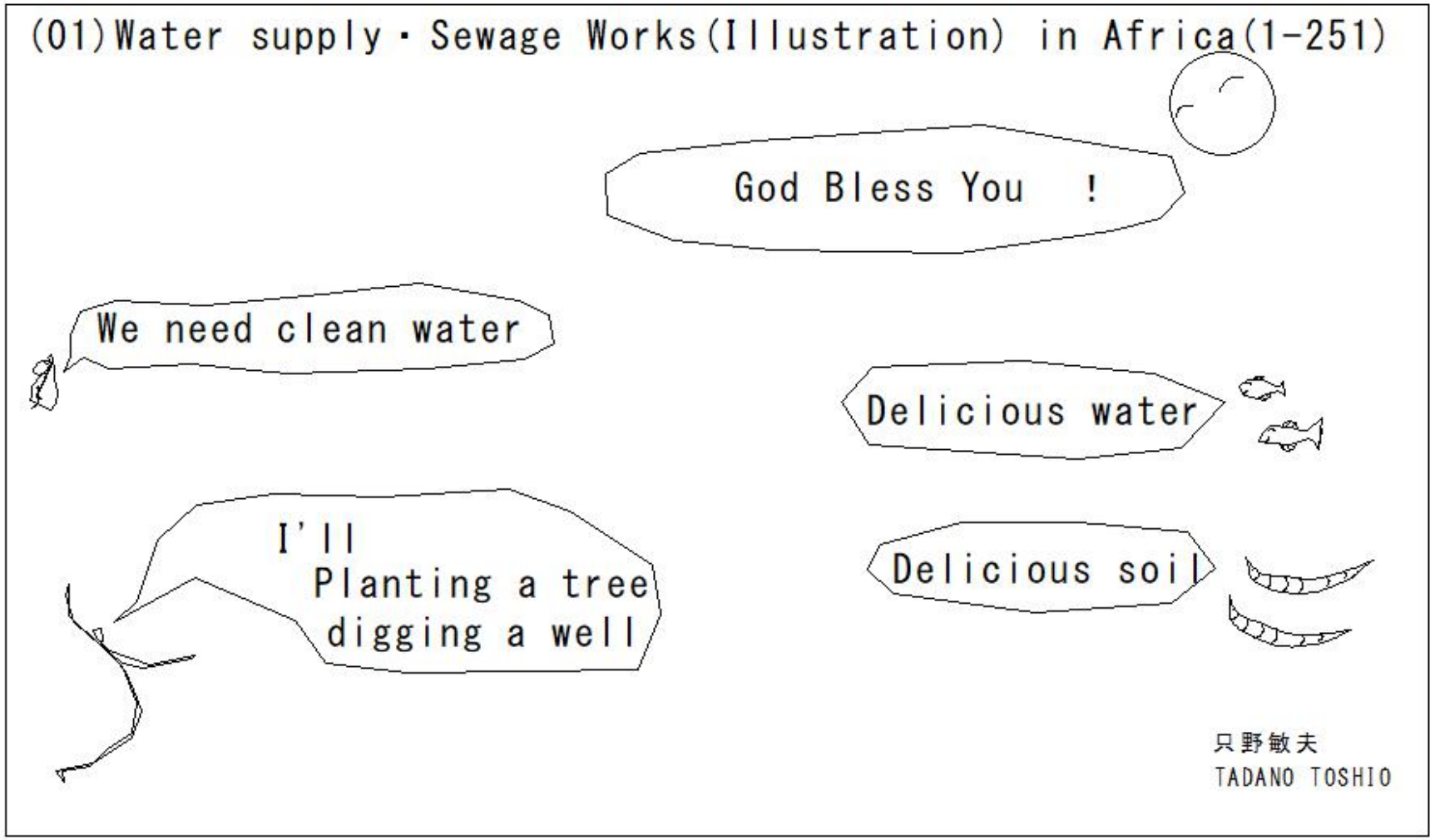
(01)Water supply・Sewage Works(Illustration) in Africa(1-251)



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只野敏夫
Tadano Toshio

(W1) Watersupply	Watersupply
(W2) Sewerage facilities	Sewerage facilities
(W3) Water supply	Watersupply
(W4) Water supply	Watersupply
(W5) Water supply	Watersupply
(W6) Water supply	Watersupply
(W7) Water supply plans	Water supply plans
(W8) Water supply（Water sources）	Water sources
(W9) Water supply（Water sources）	Water sources
(W10) Water supply（Water sources）	Water sources
(W11) Water supply（Water sources）	Water sources
(W12) Water supply（Water sources）	Water sources
(W13)Water intake facilities(Water intake dam）	Water intake dam
(W14)Water intake facilities(Water intake gate）	Water intake gate
(W15)Water intake facilities(Water intake towers）	Water intake towers
(W16)Water intake facilities(Water intake basin）	Water intake basin
(W17)Water intake facilities(Intake pipe culvert Intake culvert）	Intake pipe culvert Intake culvert
(W18)Water intake facilities(Shallow well）	Shallow well
(W19)Water intake facilities(Deep well）	Deep well
(W20)Water intake facilities(Water storage facilities）	Water storage facilities
(W21)Water intake facilities(Water conveyance）	Water conveyance
(W22)Water intake facilities(Water conveyance pipes）	Water conveyance pipes
(W23)Water intake facilities(Water conveyance pipes）	Water conveyance pipes
(W24)Water intake facilities(Water conveyance facilities-Pipelines）	Water conveyance facilities-Pipelines
(W25)Water intake facilities(Water conveyance facilities-Pipelines）	Water conveyance facilities-Pipelines
(W26)Water intake facilities(Water conveyance facilities-Pipelines）	Water conveyance facilities-Pipelines
(W27)Water intake facilities(Aqueducts and bridge-attached pipes）	Aqueducts and bridge
(W28)Water intake facilities(Plumber）	Water intake facilities-Plumber
(W29)Water supply facilities(Water purification facilities）	Water purification facilities
(W30)Water supply facilities(Water purification facilities）	Water purification facilities
(W31)Water supply facilities(Water purification facilities）	Water purification facilities
(W32)Water supply facilities(Slow sand filtration）	Slow sand filtration
(W33)Water supply facilities(Rapid sand filtration）	Rapid sand filtration
(W34)Water supply facilities(Comparison between rapid and slow sand filtration）	rapid and slow sand filtration

(W35)Water supply facilities(water purification facilities）	water purification facilities
(W36)Water supply facilities(water purification facilities）	water purification facilities
(W37)Water supply facilities(water purification facilities）	water purification facilities
(W38)Water supply facilities(water purification facilities）	water purification facilities
(W39)Water supply facilities(water purification facilities-conveyance)facilities）	water purification facilities
(W40)Water supply facilities(water purification facilities-Water distribution facilities）	water purification facilities
(W41)Water supply facilities(water purification facilities-Water distribution facilities）	water purification facilities
(W42)Water supply facilities(Water distribution facilities）	water purification facilities
(W43)Water supply facilities(Water distribution facilities）	water purification facilities
(W44)Water supply facilities(Water distribution facilities）	water purification facilities
(W45)Water supply facilities(Water distribution facilities）	water purification facilities
(W46)Water supply facilities(Water distribution facilities）	water purification facilities
(W47)Water supply facilities(Water distribution facilities）	water purification facilities
(W48)Water supply facilities(Water distribution facilities）	water purification facilities
(W49)Water supply facilities(Water supply equipment）	Water supply equipment
(W50)Water supply facilities(Water supply equipment）	Water supply equipment
(W51)Water supply facilities(Water supply equipment）	Water supply equipment
(W52)Water supply facilities(Water supply equipment）	Water supply equipment
(W53)Water supply facilities(Water supply equipment）	Water supply equipment
(W54)Water supply facilities(Water supply equipment）	Water supply equipment
(W55)Water supply facilities(Water supply equipment）	Water supply equipment
(W56)Sewerage	Sewerage
(W57)Sewerage(Public sewerage)	Sewerage(Public sewerage)
(W58)Sewerage(River basin sewerage)	Sewerage(River basin sewerage)
(W59)Sewerage(Urban sewerage)	Sewerage(Urban sewerage)
(W60)Sewerage(Specific public sewerage)	Sewerage(Specific public sewerage)
(W61)Sewerage(Permission for sewerage construction)	Sewerage(Permission)
(W62)Sewerage(Components)	Sewerage(Components)
(W63)Sewerage(Target year)	Sewerage(Target year)
(W64)Sewerage(Planning area)	Sewerage(Planning area)
(W65)Sewerage(Planned sewage volume and water quality)	Sewerage(Planned sewage volume)
(W66)Sewerage(Combined type/ Separate type)	Sewerage(Combined type/ Separate type)
(W67)Sewerage(Survey)	Sewerage(Survey)
(W68)Sewerage(Comparison of sewage methods)	Sewerage(Comparison of sewage)

(W69)Sewerage(Comparison of sewage methods)	Sewerage(Comparison of sewage)
(W70)Sewerage(Comparison of sewage methods)	Sewerage(Comparison of sewage)
(W71)Sewerage(Comparison of sewage methods)	Sewerage(Comparison of sewage)
(W72)Sewerage(Comparison of sewage methods)	Sewerage(Comparison of sewage)
(W73)Sewerage(Comparison of sewage methods)	Sewerage(Comparison of sewage)
(W74)Sewerage(Comparison of sewage methods)	Sewerage(Comparison of sewage)
(W75)Sewerage(Comparison of sewage methods)	Sewerage(Comparison of sewage)
(W76)Sewerage(Construction planning)	Sewerage(Construction planning)
(W77)Sewerage(Pipe construction)	Sewerage(Pipe construction)
(W78)Sewerage(Pumping station facilities)	Sewerage(Pumping station facilities)
(W79)Sewerage(Location of treatment plant)	Sewerage(Location of treatment plant)
(W80)Sewerage(Location of treatment plant)	Sewerage(Location of treatment plant)
(W81)Sewerage(Classification by material)	Sewerage(Classification by material)
(W82)Sewerage(Pipe cross-sectional shape)	Sewerage(Pipe cross-sectional shape)
(W83)Sewerage(Planned sewage volume)	Sewerage(Planned sewage volume)
(W84)Sewerage(Flow rate calculation and cross-section determination)	Sewerage(Flow rate calculation)
(W85)Sewerage(Pipeline Facilities)	Sewerage(Pipeline Facilities)
(W86)Sewerage(Type of pipe)	Sewerage(Type of pipe)
(W87)Sewerage(Joining of pipes)	Sewerage(Joining of pipes)
(W88)Sewerage(Types of pipe joints)	Sewerage(Types of pipe joints)
(W89)Sewerage(Types of pipe joints)	Sewerage(Types of pipe joints)
(W90)Sewerage(Types of pipe joints)	Sewerage(Types of pipe joints)
(W91)Sewerage(Types of pipe joints)	Sewerage(Types of pipe joints)
(W92)Sewerage(Types of pipe joints)	Sewerage(Types of pipe joints)
(W93)Sewerage(Types of pipe joints)	Sewerage(Types of pipe joints)
(W94)Sewerage(inverted siphon(Underpass))	Sewerage(inverted siphon(Underpass))
(W95)Sewerage(Pipe joints)	Sewerage(Pipe joints)
(W96)Sewerage(Foundation work)	Sewerage(Foundation work)
(W97)Sewerage(Foundation work)	Sewerage(Foundation work)
(W98)Sewerage(Foundation work)	Sewerage(Foundation work)
(W99)Sewerage(Foundation work)	Sewerage(Foundation work)
(W100)Sewerage(Foundation work)	Sewerage(Foundation work)
(W101)Sewerage(street inlet(rainwater catch basin))	Sewerage(street inlet)
(W102)Sewerage(Sewage manhole(house inlet))	Sewage manhole(house inlet)

(W103)Sewerage(Attachment pipe)	Sewerage(Attachment pipe)
(W104)Sewerage(Construction of pipes-Soil survey)	Sewerage(Soil survey)
(W105)Sewerage(open cut method)	Sewerage(open cut method)
(W106)Sewerage(open cut method-Wooden sheet pile method)	Sewerage(open cut method)
(W107)Sewerage(open cut method-Lightweight steel sheet pile method)	Sewerage(open cut method)
(W108)Sewerage(open cut method-Steel sheet pile construction method)	Sewerage(open cut method)
(W109)Sewerage(open cut method- H-beam sheet pile construction method)	Sewerage(open cut method)
(W110)Sewerage(Pipe construction/Cast-in-place mortar piles)	Sewerage(Cast-in-place mortar piles)
(W111)Sewerage(Covering, excavation and backfilling-Covering)	Sewerage(Covering)
(W112)Sewerage(Covering, excavation and backfilling-excavation)	Sewerage(excavation)
(W113)Sewerage(backfilling)	Sewerage(backfilling)
(W114)Sewerage(pipe jacking method)	Sewerage(pipe jacking method)
(W115)Sewerage(Cutting edge driving method)	Sewerage(Cutting edge driving method)
(W116)Sewerage(Semi-shield method)	(W116)Sewerage(Semi-shield method)
(W117)Sewerage(Small diameter jacking method)	Sewerage(Small diameter jacking method)
(W118)Sewerage (Pipe for thrust(pipe jacking))	Sewerage (Pipe for thrust(pipe jacking))
(W119)Sewerage (Improvement of pipe jacking method)	Sewerage (Improvement of pipe jacking)
(W120)Sewerage (Middle jacking method)	Sewerage (Middle jacking method)
(W121)Sewerage (Semi-shield method)	Sewerage (Semi-shield method)
(W122)Sewerage (Pumping Stations-Rainwater pumping station)	Sewerage (Pumping Stations）
(W123)Sewerage (Pump Station-Booster Pump Station)	Sewerage (Pumping Stations）
(W124)Sewerage (Pump Station-Pumping station inside treatment plant)	Sewerage (Pumping Stations）
(W125)Sewerage (Final treatment plant)	Sewerage (Final treatment plant)
(W126)Sewerage (Final treatment plant-Sewage treatment methods)	Sewerage (Final treatment plant)
(W127)Sewerage (Sewage treatment methods-plain precipitation)	Sewage treatment methodsn
(W128)Sewerage (Sewage treatment methods- Septic tank)	Sewage treatment methods- Septic tank
(W129)Sewerage (Sewage treatment methods- Two-floor tank)	Sewage treatment methods- Two-floor tank
(W130)Sewerage (Sewage treatment methods- Sand bed method)	Sewage treatment methods
(W131)Sewerage (Sewage treatment methods- Contact filter bed method)	Sewage treatment methods
(W132)Sewerage (Sewage treatment methods-Chemical precipitation)	Sewage treatment methods
(W133)Sewerage (Sewage treatment methods-Sprinkling filter bed method)	Sewage treatment methods
(W134)Sewerage (Sewage treatment methods-Activated sludge method)	Sewage treatment methods
(W135)Sewerage (Sewage treatment methods-Activated sludge method)	Sewage treatment methods
(W136)Sewerage (Sewage treatment methods-Activated sludge method)	Sewage treatment methods

(W137)Sewerage (Sewage treatment methods-Activated sludge method)	Sewage treatment methods
(W138)Sewerage (Sewage treatment methods-Activated sludge method)	Sewage treatment methods
(W139)Sewerage (Sewage treatment methods-Activated sludge method)	Sewage treatment methods
(W140)Sewerage (Final treatment plant-How to dispose of sludge)	Sewerage (Final treatment plant)
(W141)Sewerage (Final treatment plant-How to dispose of sludge)	Sewerage (Final treatment plant)
(W142)Sewerage (Final treatment plant-How to dispose of sludge)	Sewerage (Final treatment plant)
(W143)Sewerage (Final treatment plant-How to dispose of sludge)	Sewerage (Final treatment plant)
(W144)Sewerage (Final treatment plant-How to dispose of sludge)	Sewerage (Final treatment plant)
(W145)Water supply	Water supply
(W146)Water supply（Pipework support method and soil cover thickness）	Water supply（Pipework support method）
(W147)Water supply（Pipework support method and soil cover thickness）	Water supply（Pipework support method）
(W148)Water supply（Pipework support method and soil cover thickness）	Water supply（Pipework support method）
(W149)Water supply（Types and characteristics of pipes）	Water supply（Types of pipes）
(W150)Water supply（Types and characteristics of pipes）	Water supply（Types of pipes）
(W151)Water supply（Types and characteristics of pipes）	Water supply（Types of pipes）
(W152)Water supply（Types and characteristics of pipes）	Water supply（Types of pipes）
(W153)Water supply（Types and characteristics of pipes）	Water supply（Types of pipes）
(W154)Water supply（Types and characteristics of pipes）	Water supply（Types of pipes）
(W155)Water supply（Water purification(clean water) facility)	Water supply（Water purification)
(W156)Sewerage	Sewerage
(W157)Sewerage(separate system・combined system）	Sewerage
(W158)Sewerage(Sewerage systems and classification）	Sewerage
(W159)Sewerage(Joining pipes-Water Surface joint）	Sewerage(Joining pipes）
(W160)Sewerage(Joining pipes-Pipe top joint）	Sewerage(Joining pipes）
(W161)Sewerage(Joining pipes-Pipe center joint）	Sewerage(Joining pipes）
(W162)Sewerage(Joining pipes-Pipe center joint）	Sewerage(Joining pipes）
(W163)Sewerage(Foundation work for sewer pipes）	Sewerage(Foundation）
(W164)Sewerage(Foundation work for sewer pipes）	Sewerage(Foundation）
(W165)Sewerage(Foundation work for sewer pipes）	Sewerage(Foundation）
(W166)Sewerage(Foundation work for sewer pipes）	Sewerage(Foundation）
(W167)Water supply and sewerage	Water supply and sewerage
(W168)Water supply(waterworks-Bearing)	Water supply(waterworks-Bearing)
(W169)sewer(Centrifugal Reinforced Concrete Pipe-Joint Methods)	sewer(Joint Methods)
(W170)sewer(Stair joints)	sewer(Stair joints)

(W171)sewer(Activated sludge method)	sewer(Activated sludge method)
(W172)sewer(Slow filtration method)	sewer(Slow filtration method)
(W173)Sewerage(Pipe joint)	Sewerage(Pipe joint)
(W174)Sewerage(Pipe joint)	Sewerage(Pipe joint)
(W175)Water supply(return back of filtration(Filtered water backflow device))	Water supply(return back of filtration)
(W176)Water supply(inlet works(water intake facility))	Water supply(water intake facility)
(W177)Water supply(filter material)	Water supply(filter material)
(W178)Water supply(filter film)	Water supply(filter film)
(W179)Water supply(rate of filtration)	Water supply(rate of filtration)
(W180)Sewerage(separate system)	Sewerage(separate system)
(W181)Sewerage(separate system)	Sewerage(separate system)
(W182)Sewerage(Water distribution valve(ferrule))	Sewerage(Water distribution valve(ferrule))
(W183)Sewerage(Flocculator-Slow speed agitator)	Sewerage(Flocculator-Slow speed agitator)
(W184)Water supply(plain precipitation）	(W184)Water supply(plain precipitation）
(W185)Sewerage(siphon culvert)	Sewerage(siphon culvert)
(W186)Sewerage(Anaerobic digestion)	Sewerage(Anaerobic digestion)
(W187)Water supply(High-speed coagulation and sedimentation tank)	Water supply(High-speed coagulation)
(W188)Water supply(High-speed coagulation and sedimentation tank)	Water supply(High-speed coagulation)
(W189)Water supply(surface washing（Surface cleaning）)	Water supply surface washing
(W190)Sewerage(Final sedimentation tank)	Sewerage(Final sedimentation tank)
(W191)Water supply(Minimum hydraulic gradient line)	Water supply(Minimum hydraulic gradient)
(W192)Water supply(Minimum hydraulic gradient line)	Water supply(Minimum hydraulic gradient)
(W193)Water supply(Intake pipe)	Water supply(Intake pipe)
(W194)Water supply(surface washing（Surface cleaning）)	Water supply(surface washing)
(W195)Water supply and sewerage(Aqueduct)	Water supply and sewerage(Aqueduct)
(W196)Water supply(Water hammer action)	Water supply(Water hammer action)
(W197)Water supply(pipe jacking method)	Water supply(pipe jacking method)
(W198)Water supply(water-tower)	Water supply(water-tower)
(W199)Water supply(Water Distribution)	Water supply(Water Distribution)
(W200)Water supply(Water control valve)	Water supply(Water control valve)
(W201)Water supply and sewerage(Foundation work for water-conveyance (water pipes))	Water supply and sewerage(Foundation)
(W202)Sewerage(Socket joint)	Sewerage(Socket joint)
(W203)Water supply(Double filtration)	Water supply(Double filtration)
(W204)Water supply(Water softening)	Water supply(Water softening)

(W205)Water supply(trough)	Water supply(trough)
(W206)Water supply(earthenware pipe)	Water supply(earthenware pipe)
(W207)Water supply(earthenware pipe)	Water supply(earthenware pipe)
(W208)Water supply(earthenware pipe)	Water supply(earthenware pipe)
(W209)Water supply and sewerage(Earth retaining works)	Water supply (Earth retaining works)
(W210)Water supply and sewerage(Earth retaining works)	Water supply (Earth retaining works)
(W211)Water supply and sewerage(Earth retaining works)	Water supply (Earth retaining works)
(W212)Water supply and sewerage(Earth retaining works)	Water supply (Earth retaining works)
(W213)Water supply(Mud spit pipe)	Water supply(Mud spit pipe)
(W214)Water supply(Water Distribution Reservoir)	Water supply(Water Distribution Reservoir)
(W215)Water supply(Flange coupling)	Water supply(Flange coupling)
(W216)Water supply(Floc Formation Pond)	Water supply(Floc Formation Pond)
(W217)Water supply and sewerage(horizontal auger)	Water supply and sewerage(horizontal auger)
(W218)Sewerage(Manhole)	Sewerage(Manhole)
(W219)Water supply(Mechanical joint)	Water supply(Mechanical joint)
(W220)Sewerage(storm outfall(Rainwater outlet))	Sewerage(storm outfall(Rainwater outlet))
(W221)Sewerage(street inlet(Rainwater basin))	Sewerage(street inlet(Rainwater basin))
(W222)Water supply and sewerage(rainfall observation)	Water supply (rainfall observation)
(W223)Water supply and sewerage(rain gauge)	Water supply and sewerage(rain gauge)
(W224)Sewerage(house inlet(Sewage manhole))	Sewerage(house inlet(Sewage manhole))
(W225)Water supply(pumping flow system(Pressurized water distribution method))	Water supply(pumping flow system)
(W226)Water supply(activated carbon method)	(W226)Water supply(activated carbon)
(W227)Water supply(Rapid filtration)	Water supply(Rapid filtration)
(W228)Water supply(coagulation basin)	Water supply(coagulation basin)
(W229)Water supply(activated carbon method)	Water supply(activated carbon method)
(W230)sewage(seawage treatment method)	sewage(seawage treatment method)
(W231)Sewerage	Sewerage
(W232)Water supply(back washing)	Water supply(back washing)
(W233)Water supply(Washing tank)	Water supply(Washing tank)
(W234)Water supply(Elevated tank)	Water supply(Elevated tank)
(W235)Sewerage(combined system)	Sewerage(combined system)
(W236)Sewerage(sewerage of combined system)	Sewerage(sewerage of combined system)
(W237)Water supply and sewerage(mini size pipe jacking)	Water supply (mini size pipe jacking)
(W238)Sewerage(air blow system)	Sewerage(air blow system)

(W239)Sewerage(trickling filtration bed system)	Sewerage(trickling filtration bed system)
(W240)Water supply (clean water(Purified water))	Water supply (clean water(Purified water))
(W241)Water supply (purification plant)	Water supply (purification plant)
(W242)Water supply (continuous flow setting basin)	Water supply (continuous flow setting basin)
(W243)Sewerage(simplex system)	Sewerage(simplex system)
(W244)Sewerage(thickner（Sludge scraper）)	Sewerage(thickner（Sludge scraper）)
(W245)Sewerage(sludge treatment)	(W245)Sewerage(sludge treatment)
(W246)Water supply (Total head)	Water supply (Total head)
(W247)Water supply (water-conveyance equipment(Water supply facility))	Water supply (water-conveyance)
(W248)Water supply (pipeline)	Water supply (pipeline)
(W249)Water supply (pipeline)	Water supply (pipeline)
(W250)Water supply (pipeline)	Water supply (pipeline)
(W251)Water supply (pipeline)	Water supply (pipeline)

(W116)Sewerage(Semi-shield method)	(W116)Sewerage(Semi-shield method)
(W184)Water supply(plain precipitation）	(W184)Water supply(plain precipitation）
(W226)Water supply(activated carbon method)	(W226)Water supply(activated carbon)
(W245)Sewerage(sludge treatment)	(W245)Sewerage(sludge treatment)
(W27)Water intake facilities(Aqueducts and bridge-attached pipes）	Aqueducts and bridge
(W19)Water intake facilities(Deep well）	Deep well
(W17)Water intake facilities(Intake pipe culvert Intake culvert）	Intake pipe culvert Intake culvert
(W34)Water supply facilities(Comparison between rapid and slow sand filtration）	rapid and slow sand filtration
(W33)Water supply facilities(Rapid sand filtration）	Rapid sand filtration
(W102)Sewerage(Sewage manhole(house inlet))	Sewage manhole(house inlet)
(W130)Sewerage (Sewage treatment methods- Sand bed method)	Sewage treatment methods
(W131)Sewerage (Sewage treatment methods- Contact filter bed method)	Sewage treatment methods
(W132)Sewerage (Sewage treatment methods-Chemical precipitation)	Sewage treatment methods
(W133)Sewerage (Sewage treatment methods-Sprinkling filter bed method)	Sewage treatment methods
(W134)Sewerage (Sewage treatment methods-Activated sludge method)	Sewage treatment methods
(W135)Sewerage (Sewage treatment methods-Activated sludge method)	Sewage treatment methods
(W136)Sewerage (Sewage treatment methods-Activated sludge method)	Sewage treatment methods
(W137)Sewerage (Sewage treatment methods-Activated sludge method)	Sewage treatment methods
(W138)Sewerage (Sewage treatment methods-Activated sludge method)	Sewage treatment methods
(W139)Sewerage (Sewage treatment methods-Activated sludge method)	Sewage treatment methods
(W128)Sewerage (Sewage treatment methods- Septic tank)	Sewage treatment methods- Septic tank
(W129)Sewerage (Sewage treatment methods- Two-floor tank)	Sewage treatment methods- Two-floor tank
(W127)Sewerage (Sewage treatment methods-plain precipitation)	Sewage treatment methodsn
(W230)sewage(seawage treatment method)	sewage(seawage treatment method)
(W171)sewer(Activated sludge method)	sewer(Activated sludge method)
(W169)sewer(Centrifugal Reinforced Concrete Pipe-Joint Methods)	sewer(Joint Methods)
(W172)sewer(Slow filtration method)	sewer(Slow filtration method)
(W170)sewer(Stair joints)	sewer(Stair joints)
(W56)Sewerage	Sewerage
(W156)Sewerage	Sewerage
(W157)Sewerage(separate system・combined system）	Sewerage
(W158)Sewerage(Sewerage systems and classification）	Sewerage
(W231)Sewerage	Sewerage
(W125)Sewerage (Final treatment plant)	Sewerage (Final treatment plant)

(W126)Sewerage (Final treatment plant-Sewage treatment methods)	Sewerage (Final treatment plant)
(W140)Sewerage (Final treatment plant-How to dispose of sludge)	Sewerage (Final treatment plant)
(W141)Sewerage (Final treatment plant-How to dispose of sludge)	Sewerage (Final treatment plant)
(W142)Sewerage (Final treatment plant-How to dispose of sludge)	Sewerage (Final treatment plant)
(W143)Sewerage (Final treatment plant-How to dispose of sludge)	Sewerage (Final treatment plant)
(W144)Sewerage (Final treatment plant-How to dispose of sludge)	Sewerage (Final treatment plant)
(W119)Sewerage (Improvement of pipe jacking method)	Sewerage (Improvement of pipe jacking)
(W120)Sewerage (Middle jacking method)	Sewerage (Middle jacking method)
(W118)Sewerage (Pipe for thrust(pipe jacking))	Sewerage (Pipe for thrust(pipe jacking))
(W122)Sewerage (Pumping Stations-Rainwater pumping station)	Sewerage (Pumping Stations）
(W123)Sewerage (Pump Station-Booster Pump Station)	Sewerage (Pumping Stations）
(W124)Sewerage (Pump Station-Pumping station inside treatment plant)	Sewerage (Pumping Stations）
(W121)Sewerage (Semi-shield method)	Sewerage (Semi-shield method)
(W2) Sewerage facilities	Sewerage facilities
(W66)Sewerage(Combined type/ Separate type)	Sewerage(Combined type/ Separate type)
(W238)Sewerage(air blow system)	Sewerage(air blow system)
(W186)Sewerage(Anaerobic digestion)	Sewerage(Anaerobic digestion)
(W103)Sewerage(Attachment pipe)	Sewerage(Attachment pipe)
(W113)Sewerage(backfilling)	Sewerage(backfilling)
(W110)Sewerage(Pipe construction/Cast-in-place mortar piles)	Sewerage(Cast-in-place mortar piles)
(W81)Sewerage(Classification by material)	Sewerage(Classification by material)
(W235)Sewerage(combined system)	Sewerage(combined system)
(W68)Sewerage(Comparison of sewage methods)	Sewerage(Comparison of sewage)
(W69)Sewerage(Comparison of sewage methods)	Sewerage(Comparison of sewage)
(W70)Sewerage(Comparison of sewage methods)	Sewerage(Comparison of sewage)
(W71)Sewerage(Comparison of sewage methods)	Sewerage(Comparison of sewage)
(W72)Sewerage(Comparison of sewage methods)	Sewerage(Comparison of sewage)
(W73)Sewerage(Comparison of sewage methods)	Sewerage(Comparison of sewage)
(W74)Sewerage(Comparison of sewage methods)	Sewerage(Comparison of sewage)
(W75)Sewerage(Comparison of sewage methods)	Sewerage(Comparison of sewage)
(W62)Sewerage(Components)	Sewerage(Components)
(W76)Sewerage(Construction planning)	Sewerage(Construction planning)
(W111)Sewerage(Covering, excavation and backfilling-Covering)	Sewerage(Covering)
(W115)Sewerage(Cutting edge driving method)	Sewerage(Cutting edge driving method)

(W112)Sewerage(Covering, excavation and backfilling-excavation)	Sewerage(excavation)
(W190)Sewerage(Final sedimentation tank)	Sewerage(Final sedimentation tank)
(W183)Sewerage(Flocculator-Slow speed agitator)	Sewerage(Flocculator-Slow speed agitator)
(W84)Sewerage(Flow rate calculation and cross-section determination)	Sewerage(Flow rate calculation)
(W96)Sewerage(Foundation work)	Sewerage(Foundation work)
(W97)Sewerage(Foundation work)	Sewerage(Foundation work)
(W98)Sewerage(Foundation work)	Sewerage(Foundation work)
(W99)Sewerage(Foundation work)	Sewerage(Foundation work)
(W100)Sewerage(Foundation work)	Sewerage(Foundation work)
(W163)Sewerage(Foundation work for sewer pipes）	Sewerage(Foundation）
(W164)Sewerage(Foundation work for sewer pipes）	Sewerage(Foundation）
(W165)Sewerage(Foundation work for sewer pipes）	Sewerage(Foundation）
(W166)Sewerage(Foundation work for sewer pipes）	Sewerage(Foundation）
(W224)Sewerage(house inlet(Sewage manhole))	Sewerage(house inlet(Sewage manhole))
(W94)Sewerage(inverted siphon(Underpass))	Sewerage(inverted siphon(Underpass))
(W87)Sewerage(Joining of pipes)	Sewerage(Joining of pipes)
(W159)Sewerage(Joining pipes-Water Surface joint）	Sewerage(Joining pipes）
(W160)Sewerage(Joining pipes-Pipe top joint）	Sewerage(Joining pipes）
(W161)Sewerage(Joining pipes-Pipe center joint）	Sewerage(Joining pipes）
(W162)Sewerage(Joining pipes-Pipe center joint）	Sewerage(Joining pipes）
(W79)Sewerage(Location of treatment plant)	Sewerage(Location of treatment plant)
(W80)Sewerage(Location of treatment plant)	Sewerage(Location of treatment plant)
(W218)Sewerage(Manhole)	Sewerage(Manhole)
(W105)Sewerage(open cut method)	Sewerage(open cut method)
(W106)Sewerage(open cut method-Wooden sheet pile method)	Sewerage(open cut method)
(W107)Sewerage(open cut method-Lightweight steel sheet pile method)	Sewerage(open cut method)
(W108)Sewerage(open cut method-Steel sheet pile construction method)	Sewerage(open cut method)
(W109)Sewerage(open cut method- H-beam sheet pile construction method)	Sewerage(open cut method)
(W61)Sewerage(Permission for sewerage construction)	Sewerage(Permission)
(W77)Sewerage(Pipe construction)	Sewerage(Pipe construction)
(W82)Sewerage(Pipe cross-sectional shape)	Sewerage(Pipe cross-sectional shape)
(W114)Sewerage(pipe jacking method)	Sewerage(pipe jacking method)
(W173)Sewerage(Pipe joint)	Sewerage(Pipe joint)
(W174)Sewerage(Pipe joint)	Sewerage(Pipe joint)

(W95)Sewerage(Pipe joints)	Sewerage(Pipe joints)
(W85)Sewerage(Pipeline Facilities)	Sewerage(Pipeline Facilities)
(W65)Sewerage(Planned sewage volume and water quality)	Sewerage(Planned sewage volume)
(W83)Sewerage(Planned sewage volume)	Sewerage(Planned sewage volume)
(W64)Sewerage(Planning area)	Sewerage(Planning area)
(W57)Sewerage(Public sewerage)	Sewerage(Public sewerage)
(W78)Sewerage(Pumping station facilities)	Sewerage(Pumping station facilities)
(W58)Sewerage(River basin sewerage)	Sewerage(River basin sewerage)
(W180)Sewerage(separate system)	Sewerage(separate system)
(W181)Sewerage(separate system)	Sewerage(separate system)
(W236)Sewerage(sewerage of combined system)	Sewerage(sewerage of combined system)
(W243)Sewerage(simplex system)	Sewerage(simplex system)
(W185)Sewerage(siphon culvert)	Sewerage(siphon culvert)
(W117)Sewerage(Small diameter jacking method)	Sewerage(Small diameter jacking method)
(W202)Sewerage(Socket joint)	Sewerage(Socket joint)
(W104)Sewerage(Construction of pipes-Soil survey)	Sewerage(Soil survey)
(W60)Sewerage(Specific public sewerage)	Sewerage(Specific public sewerage)
(W220)Sewerage(storm outfall(Rainwater outlet))	Sewerage(storm outfall(Rainwater outlet))
(W221)Sewerage(street inlet(Rainwater basin))	Sewerage(street inlet(Rainwater basin))
(W101)Sewerage(street inlet(rainwater catch basin))	Sewerage(street inlet)
(W67)Sewerage(Survey)	Sewerage(Survey)
(W63)Sewerage(Target year)	Sewerage(Target year)
(W244)Sewerage(thickner（Sludge scraper）)	Sewerage(thickner（Sludge scraper）)
(W239)Sewerage(trickling filtration bed system)	Sewerage(trickling filtration bed system)
(W86)Sewerage(Type of pipe)	Sewerage(Type of pipe)
(W88)Sewerage(Types of pipe joints)	Sewerage(Types of pipe joints)
(W89)Sewerage(Types of pipe joints)	Sewerage(Types of pipe joints)
(W90)Sewerage(Types of pipe joints)	Sewerage(Types of pipe joints)
(W91)Sewerage(Types of pipe joints)	Sewerage(Types of pipe joints)
(W92)Sewerage(Types of pipe joints)	Sewerage(Types of pipe joints)
(W93)Sewerage(Types of pipe joints)	Sewerage(Types of pipe joints)
(W59)Sewerage(Urban sewerage)	Sewerage(Urban sewerage)
(W182)Sewerage(Water distribution valve(ferrule))	Sewerage(Water distribution valve(ferrule))
(W18)Water intake facilities(Shallow well）	Shallow well

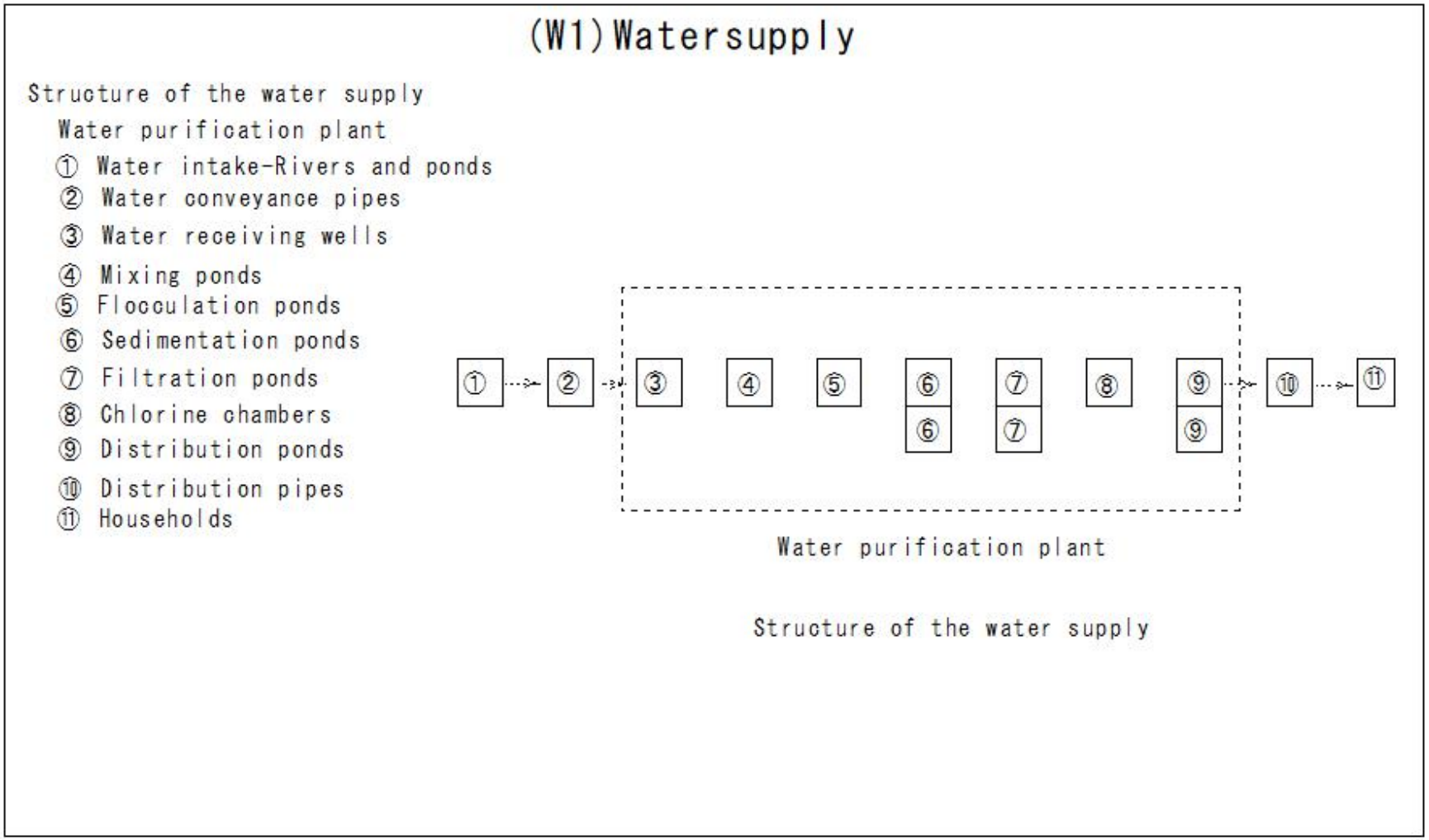
(W32)Water supply facilities(Slow sand filtration）	Slow sand filtration
(W21)Water intake facilities(Water conveyance）	Water conveyance
(W24)Water intake facilities(Water conveyance facilities-Pipelines）	Water conveyance facilities-Pipelines
(W25)Water intake facilities(Water conveyance facilities-Pipelines）	Water conveyance facilities-Pipelines
(W26)Water intake facilities(Water conveyance facilities-Pipelines）	Water conveyance facilities-Pipelines
(W22)Water intake facilities(Water conveyance pipes）	Water conveyance pipes
(W23)Water intake facilities(Water conveyance pipes）	Water conveyance pipes
(W16)Water intake facilities(Water intake basin）	Water intake basin
(W13)Water intake facilities(Water intake dam）	Water intake dam
(W28)Water intake facilities(Plumber）	Water intake facilities-Plumber
(W14)Water intake facilities(Water intake gate）	Water intake gate
(W15)Water intake facilities(Water intake towers）	Water intake towers
(W29)Water supply facilities(Water purification facilities）	Water purification facilities
(W30)Water supply facilities(Water purification facilities）	Water purification facilities
(W31)Water supply facilities(Water purification facilities）	Water purification facilities
(W35)Water supply facilities(water purification facilities）	water purification facilities
(W36)Water supply facilities(water purification facilities）	water purification facilities
(W37)Water supply facilities(water purification facilities）	water purification facilities
(W38)Water supply facilities(water purification facilities）	water purification facilities
(W39)Water supply facilities(water purification facilities-conveyance)facilities）	water purification facilities
(W40)Water supply facilities(water purification facilities-Water distribution facilities）	water purification facilities
(W41)Water supply facilities(water purification facilities-Water distribution facilities）	water purification facilities
(W42)Water supply facilities(Water distribution facilities）	water purification facilities
(W43)Water supply facilities(Water distribution facilities）	water purification facilities
(W44)Water supply facilities(Water distribution facilities）	water purification facilities
(W45)Water supply facilities(Water distribution facilities）	water purification facilities
(W46)Water supply facilities(Water distribution facilities）	water purification facilities
(W47)Water supply facilities(Water distribution facilities）	water purification facilities
(W48)Water supply facilities(Water distribution facilities）	water purification facilities
(W8) Water supply（Water sources）	Water sources
(W9) Water supply（Water sources）	Water sources
(W10) Water supply（Water sources）	Water sources
(W11) Water supply（Water sources）	Water sources
(W12) Water supply（Water sources）	Water sources

(W20)Water intake facilities(Water storage facilities）	Water storage facilities
(W145)Water supply	Water supply
(W240)Water supply (clean water(Purified water))	Water supply (clean water(Purified water))
(W242)Water supply (continuous flow setting basin)	Water supply (continuous flow setting basin)
(W209)Water supply and sewerage(Earth retaining works)	Water supply (Earth retaining works)
(W210)Water supply and sewerage(Earth retaining works)	Water supply (Earth retaining works)
(W211)Water supply and sewerage(Earth retaining works)	Water supply (Earth retaining works)
(W212)Water supply and sewerage(Earth retaining works)	Water supply (Earth retaining works)
(W237)Water supply and sewerage(mini size pipe jacking)	Water supply (mini size pipe jacking)
(W248)Water supply (pipeline)	Water supply (pipeline)
(W249)Water supply (pipeline)	Water supply (pipeline)
(W250)Water supply (pipeline)	Water supply (pipeline)
(W251)Water supply (pipeline)	Water supply (pipeline)
(W241)Water supply (purification plant)	Water supply (purification plant)
(W222)Water supply and sewerage(rainfall observation)	Water supply (rainfall observation)
(W246)Water supply (Total head)	Water supply (Total head)
(W247)Water supply (water-conveyance equipment(Water supply facility))	Water supply (water-conveyance)
(W167)Water supply and sewerage	Water supply and sewerage
(W195)Water supply and sewerage(Aqueduct)	Water supply and sewerage(Aqueduct)
(W201)Water supply and sewerage(Foundation work for water-conveyance (water pipes))	Water supply and sewerage(Foundation)
(W217)Water supply and sewerage(horizontal auger)	Water supply and sewerage(horizontal auger)
(W223)Water supply and sewerage(rain gauge)	Water supply and sewerage(rain gauge)
(W49)Water supply facilities(Water supply equipment）	Water supply equipment
(W50)Water supply facilities(Water supply equipment）	Water supply equipment
(W51)Water supply facilities(Water supply equipment）	Water supply equipment
(W52)Water supply facilities(Water supply equipment）	Water supply equipment
(W53)Water supply facilities(Water supply equipment）	Water supply equipment
(W54)Water supply facilities(Water supply equipment）	Water supply equipment
(W55)Water supply facilities(Water supply equipment）	Water supply equipment
(W7) Water supply plans	Water supply plans
(W189)Water supply(surface washing（Surface cleaning）)	Water supply surface washing
(W229)Water supply(activated carbon method)	Water supply(activated carbon method)
(W232)Water supply(back washing)	Water supply(back washing)
(W228)Water supply(coagulation basin)	Water supply(coagulation basin)

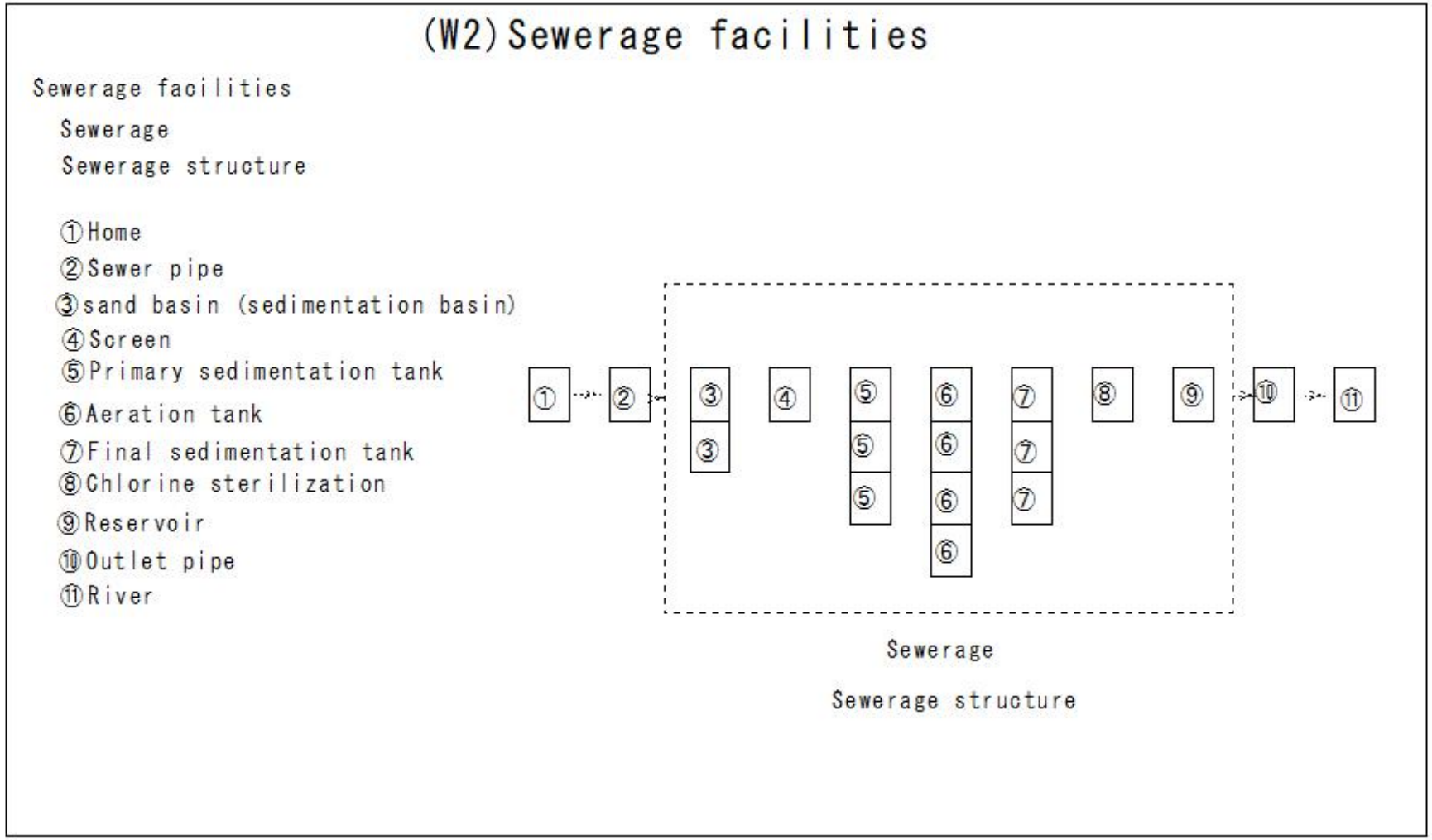
(W203)Water supply(Double filtration)	Water supply(Double filtration)
(W206)Water supply(earthenware pipe)	Water supply(earthenware pipe)
(W207)Water supply(earthenware pipe)	Water supply(earthenware pipe)
(W208)Water supply(earthenware pipe)	Water supply(earthenware pipe)
(W234)Water supply(Elevated tank)	Water supply(Elevated tank)
(W178)Water supply(filter film)	Water supply(filter film)
(W177)Water supply(filter material)	Water supply(filter material)
(W215)Water supply(Flange coupling)	Water supply(Flange coupling)
(W216)Water supply(Floc Formation Pond)	Water supply(Floc Formation Pond)
(W187)Water supply(High-speed coagulation and sedimentation tank)	Water supply(High-speed coagulation)
(W188)Water supply(High-speed coagulation and sedimentation tank)	Water supply(High-speed coagulation)
(W193)Water supply(Intake pipe)	Water supply(Intake pipe)
(W219)Water supply(Mechanical joint)	Water supply(Mechanical joint)
(W191)Water supply(Minimum hydraulic gradient line)	Water supply(Minimum hydraulic gradient)
(W192)Water supply(Minimum hydraulic gradient line)	Water supply(Minimum hydraulic gradient)
(W213)Water supply(Mud spit pipe)	Water supply(Mud spit pipe)
(W197)Water supply(pipe jacking method)	Water supply(pipe jacking method)
(W146)Water supply（Pipework support method and soil cover thickness）	Water supply（Pipework support method）
(W147)Water supply（Pipework support method and soil cover thickness）	Water supply（Pipework support method）
(W148)Water supply（Pipework support method and soil cover thickness）	Water supply（Pipework support method）
(W225)Water supply(pumping flow system(Pressurized water distribution method))	Water supply(pumping flow system)
(W227)Water supply(Rapid filtration)	Water supply(Rapid filtration)
(W179)Water supply(rate of filtration)	Water supply(rate of filtration)
(W175)Water supply(return back of filtration(Filtered water backflow device))	Water supply(return back of filtration)
(W194)Water supply(surface washing（Surface cleaning）)	Water supply(surface washing)
(W205)Water supply(trough)	Water supply(trough)
(W149)Water supply（Types and characteristics of pipes）	Water supply（Types of pipes）
(W150)Water supply（Types and characteristics of pipes）	Water supply（Types of pipes）
(W151)Water supply（Types and characteristics of pipes）	Water supply（Types of pipes）
(W152)Water supply（Types and characteristics of pipes）	Water supply（Types of pipes）
(W153)Water supply（Types and characteristics of pipes）	Water supply（Types of pipes）
(W154)Water supply（Types and characteristics of pipes）	Water supply（Types of pipes）
(W233)Water supply(Washing tank)	Water supply(Washing tank)
(W200)Water supply(Water control valve)	Water supply(Water control valve)

(W214)Water supply(Water Distribution Reservoir)	Water supply(Water Distribution Reservoir)
(W199)Water supply(Water Distribution)	Water supply(Water Distribution)
(W196)Water supply(Water hammer action)	Water supply(Water hammer action)
(W176)Water supply(inlet works(water intake facility))	Water supply(water intake facility)
(W155)Water supply（Water purification(clean water) facility)	Water supply（Water purification)
(W204)Water supply(Water softening)	Water supply(Water softening)
(W198)Water supply(water-tower)	Water supply(water-tower)
(W168)Water supply(waterworks-Bearing)	Water supply(waterworks-Bearing)
(W1) Watersupply	Watersupply
(W3) Water supply	Watersupply
(W4) Water supply	Watersupply
(W5) Water supply	Watersupply
(W6) Water supply	Watersupply

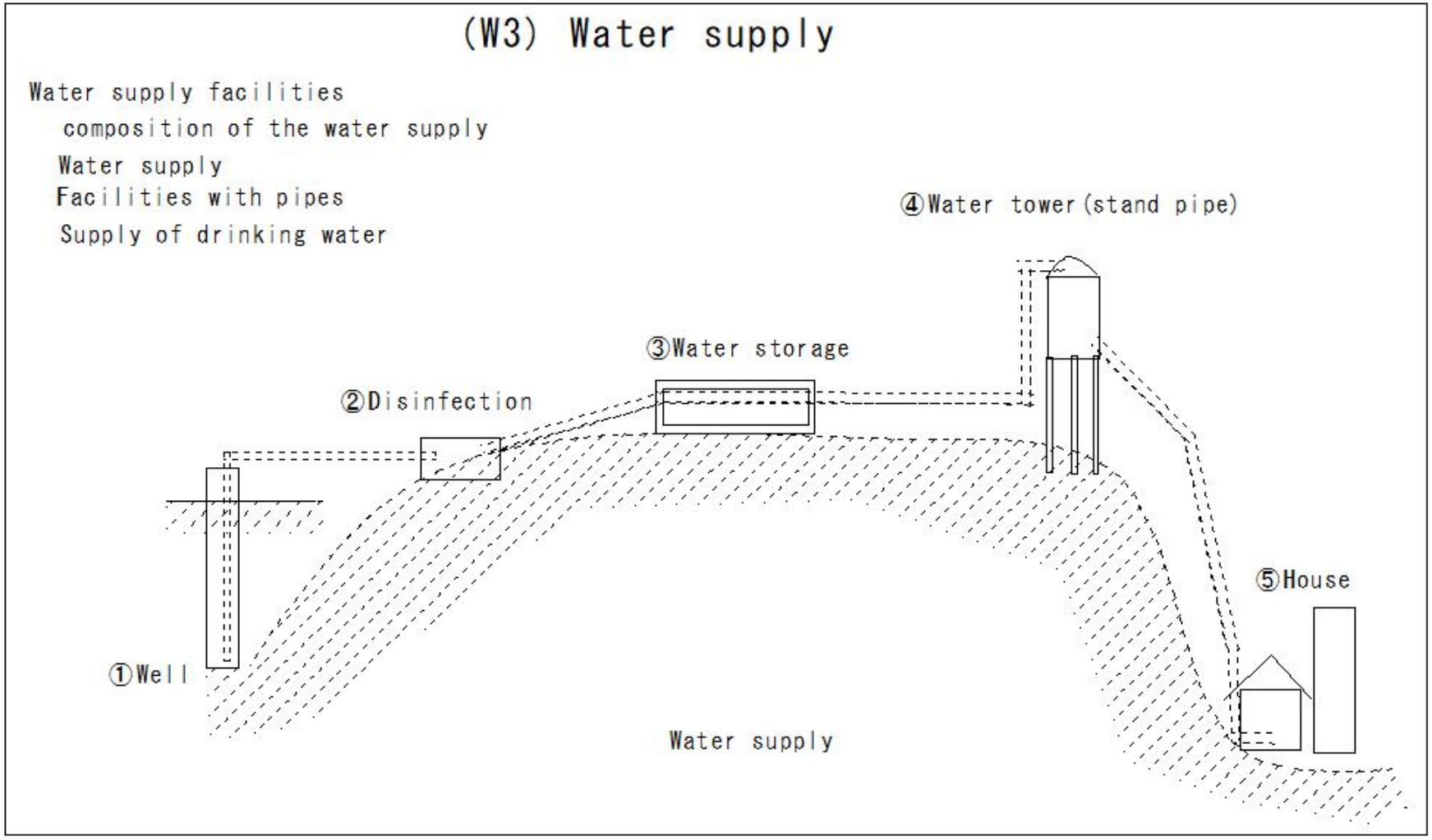
(W1)Watersupply



(W2)Sewerage facilities



(W3) Water supply



(W4) Water supply

(W4) Water supply

Water supply facilities

Composition of water supply

Water supply

Water quality standards

①No contaminating organisms

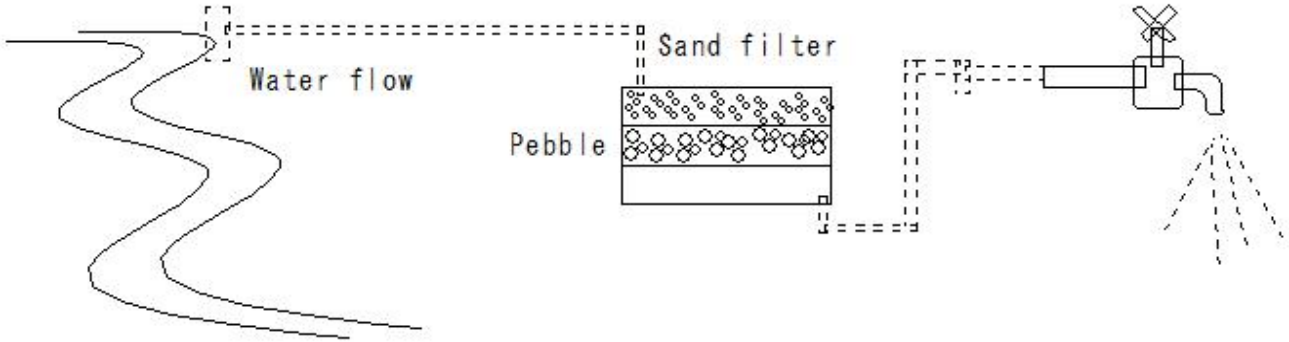
②Cyanide and mercury: No toxic substances

③Copper, iron, fluorine, and phenol: Not exceeding the permissible limit

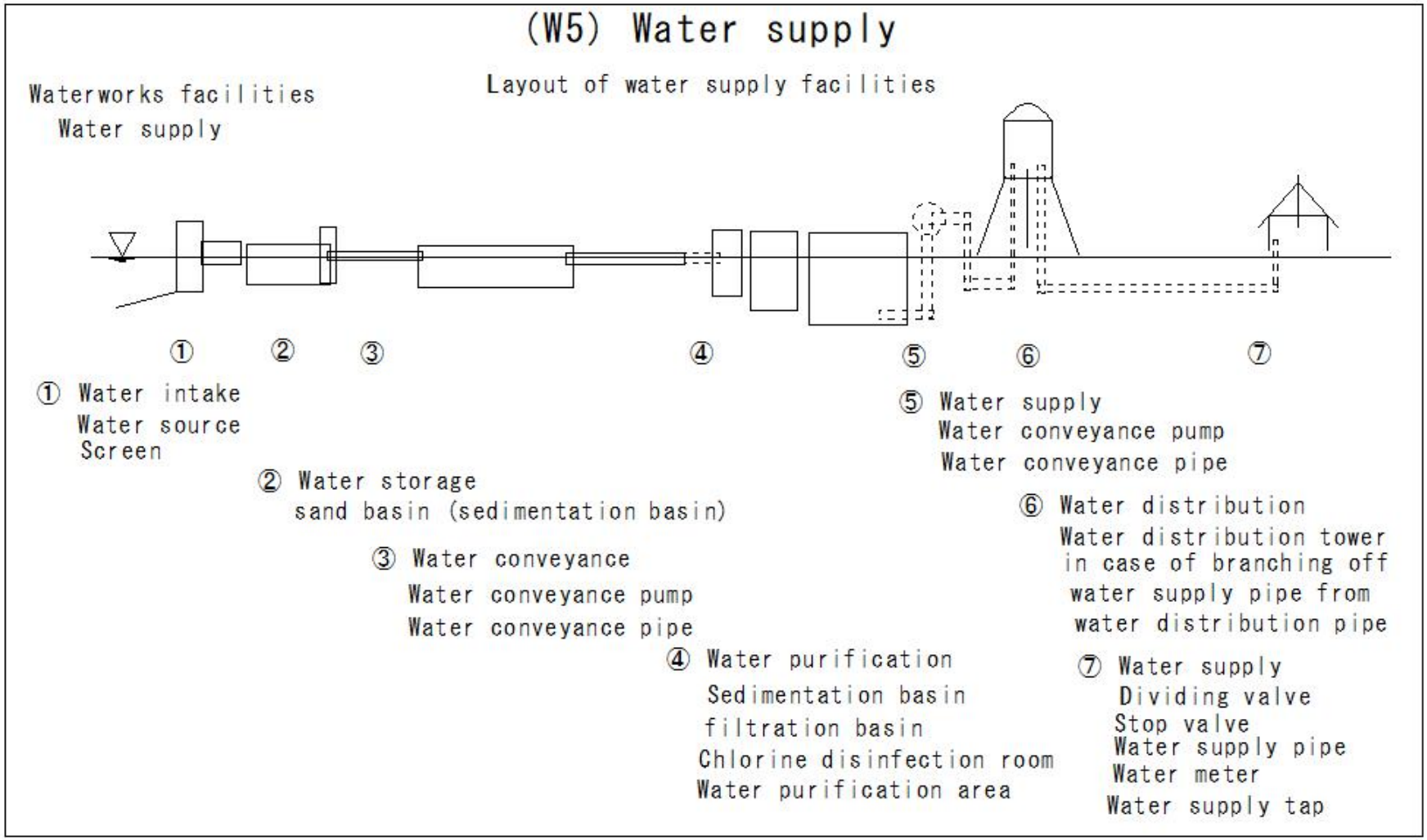
④Not abnormally acidic or alkaline

⑤No abnormal taste or odor

⑥Colorless and transparent



(W5) Water supply



(W6) Water supply

(W6) Water supply

Waterworks facilities

Water supply

Design standards for waterworks

Standards for waterworks and waterworks facilities

① Water intake facilities: Capable of taking in high-quality raw water

② Water storage facilities: Sufficient water storage capacity

③ Water conveyance facilities: Pumps and water conveyance pipes that can convey raw water

④ Water purification facilities: Sedimentation ponds, filtration ponds, disinfection facilities

⑤ Water supply facilities: Pumps, water supply pipes

⑥ Water distribution facilities: Ponds, pumps, drainage pipes

⑦ Waterworks facilities: Water pressure, earth pressure, and earthquake forces: Sufficient resistance.Water is not contaminated or leaks

① Water intake facilities: Water source, screen

② Water storage facilities: Settling pond

③ Water conveyance facilities: Water conveyance pumps, water conveyance pipes

④ Water purification facilities: Sedimentation ponds, filtration ponds, chlorine disinfection chambers, purified water ponds

⑤ Water supply facilities: Water supply pumps, water supply pipes

⑥ Water distribution facilities: Water distribution towers, water distribution pipes

⑦ Waterworks facilities: Branch valves, stop valves, water supply pipes, water meters, water supply valves

(W7) Water supply plans

(W7) Water supply plans

Water supply facilities

Water supply plans

① Annual plans

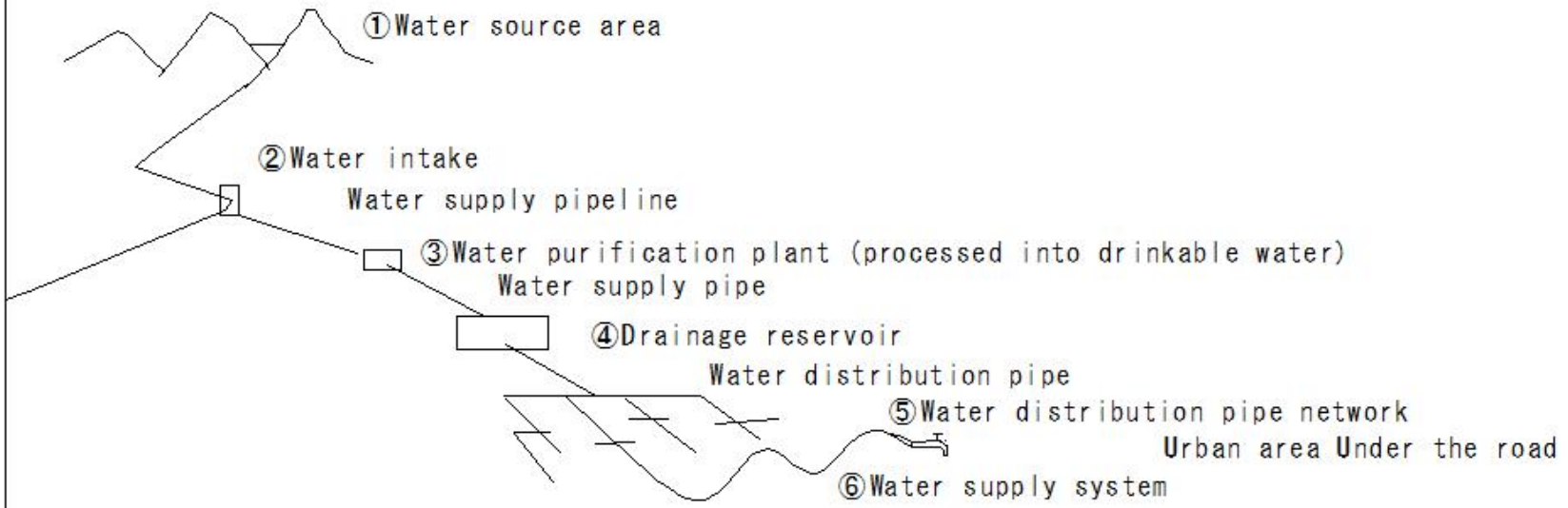
Target for about 10 years from now

② Planned water supply area

③ Planned water supply population

④ Planned water supply volume

⑤ Facility layout



(W8) Water supply（Water sources）

(W8) Water supply (Water sources)

Water supply facilities

Water supply planning

Water sources

Water sources for water supply

Surface water and groundwater

Surface water: river water and lake water

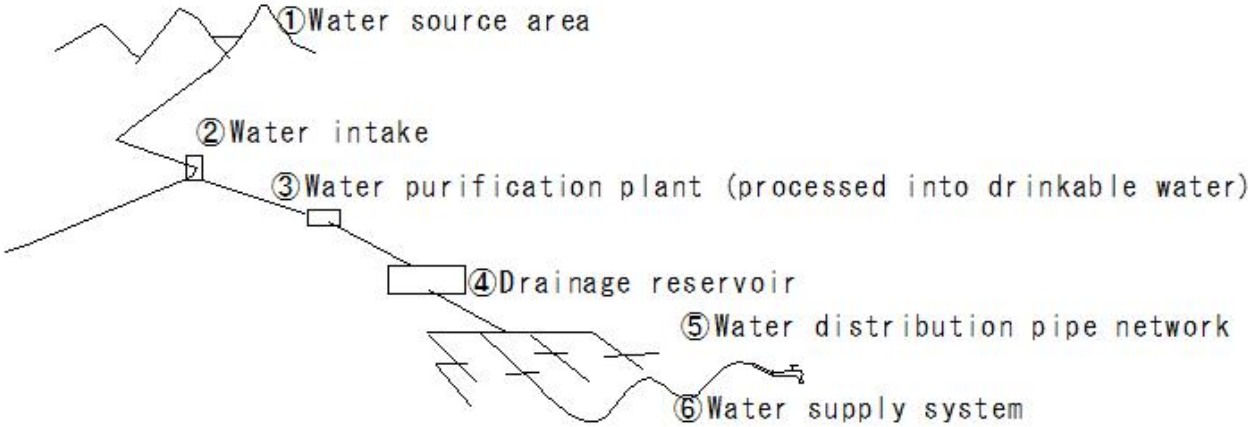
Conditions for water sources for water supply

① Required amount of raw water

② Good water quality, economical water purification

③ No pollution

④ Water intake facilities: Low construction and maintenance costs

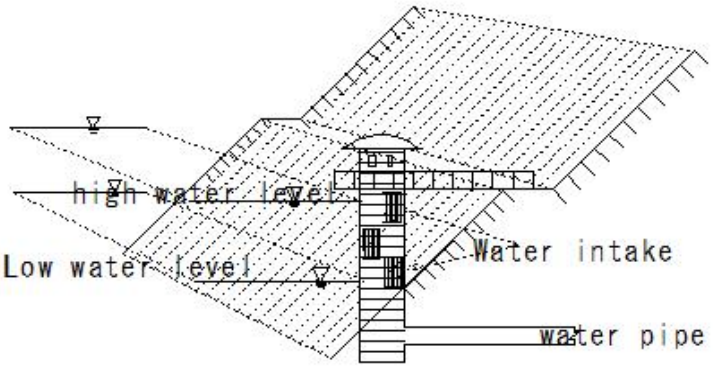


W7

(W9) Water supply（Water sources）

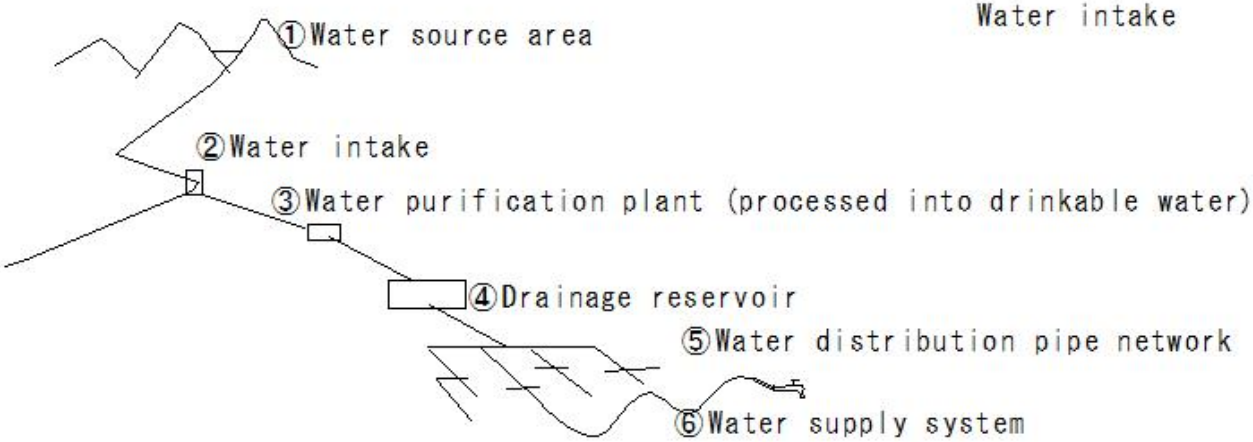
(W9) Water supply (Water sources)

Water supply facilities
- Water supply planning
- Water source
- ①River water
- ①Water volume/level
  - ・plenty of water can be taken throughout the year
- Points to note
  - ・Layout for safe and reliable water intake
  - ・Flooding/surveys at maximum drought



R374

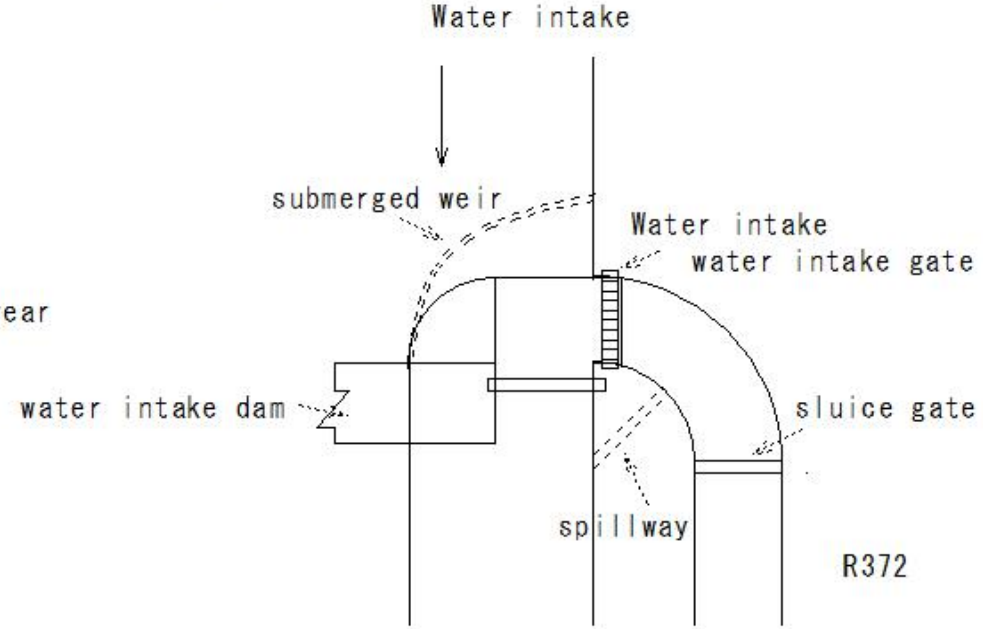
Water intake

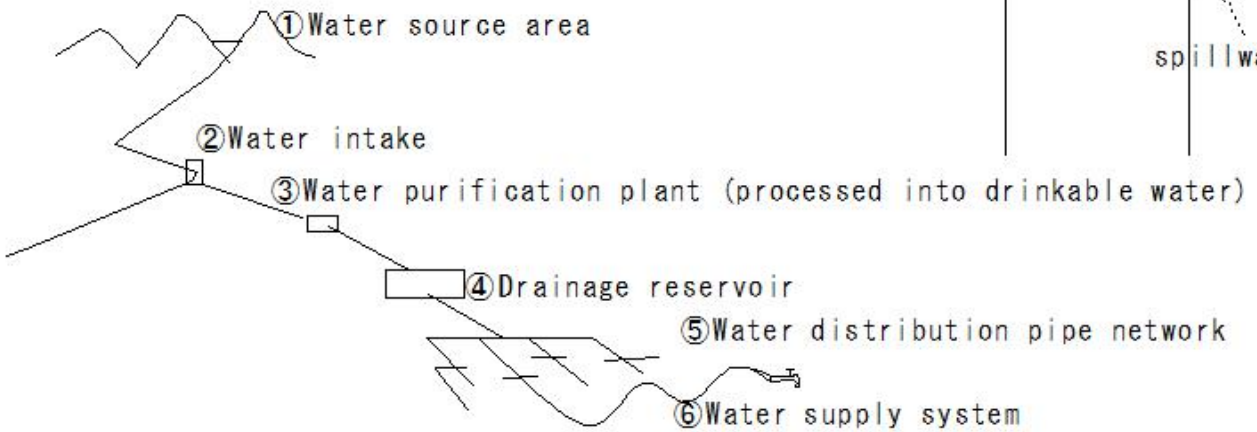


(W10) Water supply（Water sources）

(W10) Water supply (Water sources)

Water supply facilities
Water supply planning
Water source
①River water
②Water quality
・Turbidity changes during floods
・Water quality surveys throughout the year
Determine water purification method





(W11) Water supply（Water sources）

(W11) Water supply (Water sources)

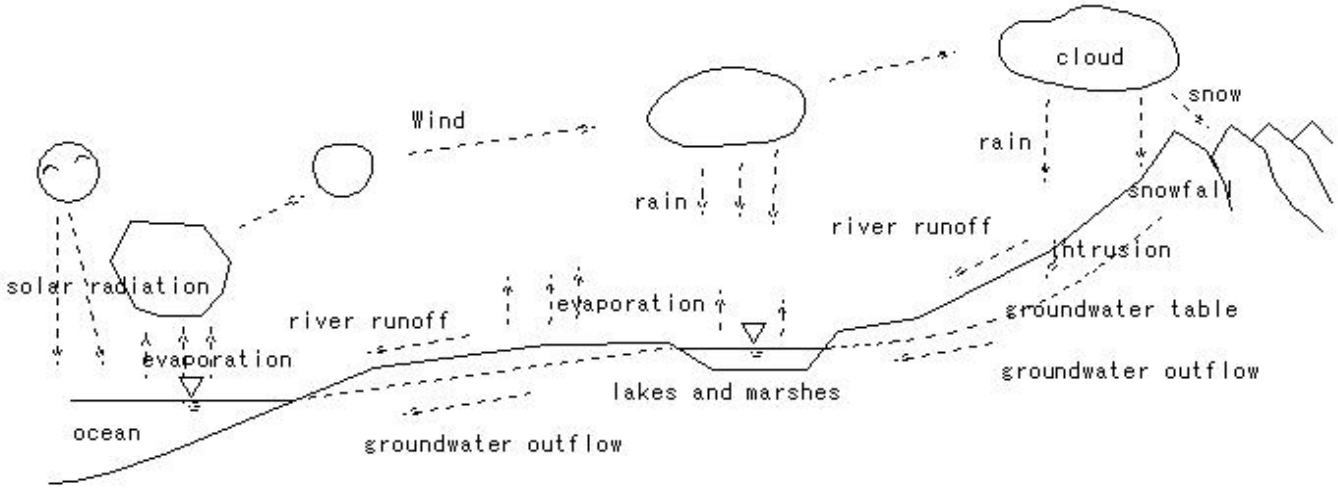
Waterworks facilities

Waterworks planning

Water sources

②Lake water

- Pay attention to water quality, such as eutrophication
- Water quality: Varies depending on coastal conditions, wind direction, and wind speed
- Inflowing rivers
- Microbial occurrence



R183

(W12) Water supply（Water sources）

(W12) Water supply (Water sources)

Waterworks facilities

Waterworks plans

Water sources

③ Groundwater

・Water quality - Good

・Difficulty in drawing large amounts of water

・Simple water supply - Small water supply

Underground flow:

Under the sand layer of the river

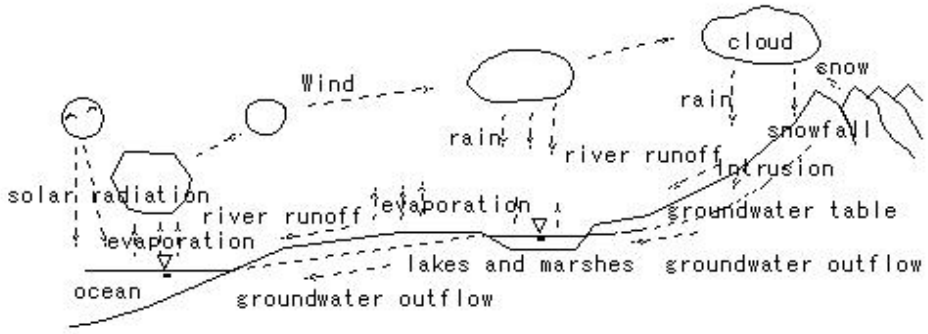
Spring water: Groundwater that naturally comes to the surface

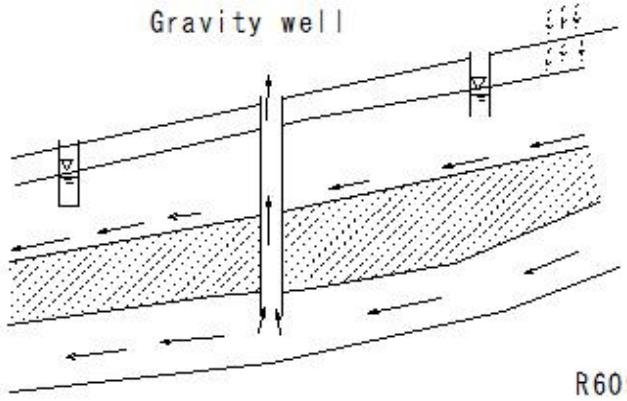
Groundwater sources - Points to note

① Coastal areas: Not affected by seawater

② Factory wastewater/sewage: No infiltration of sewage

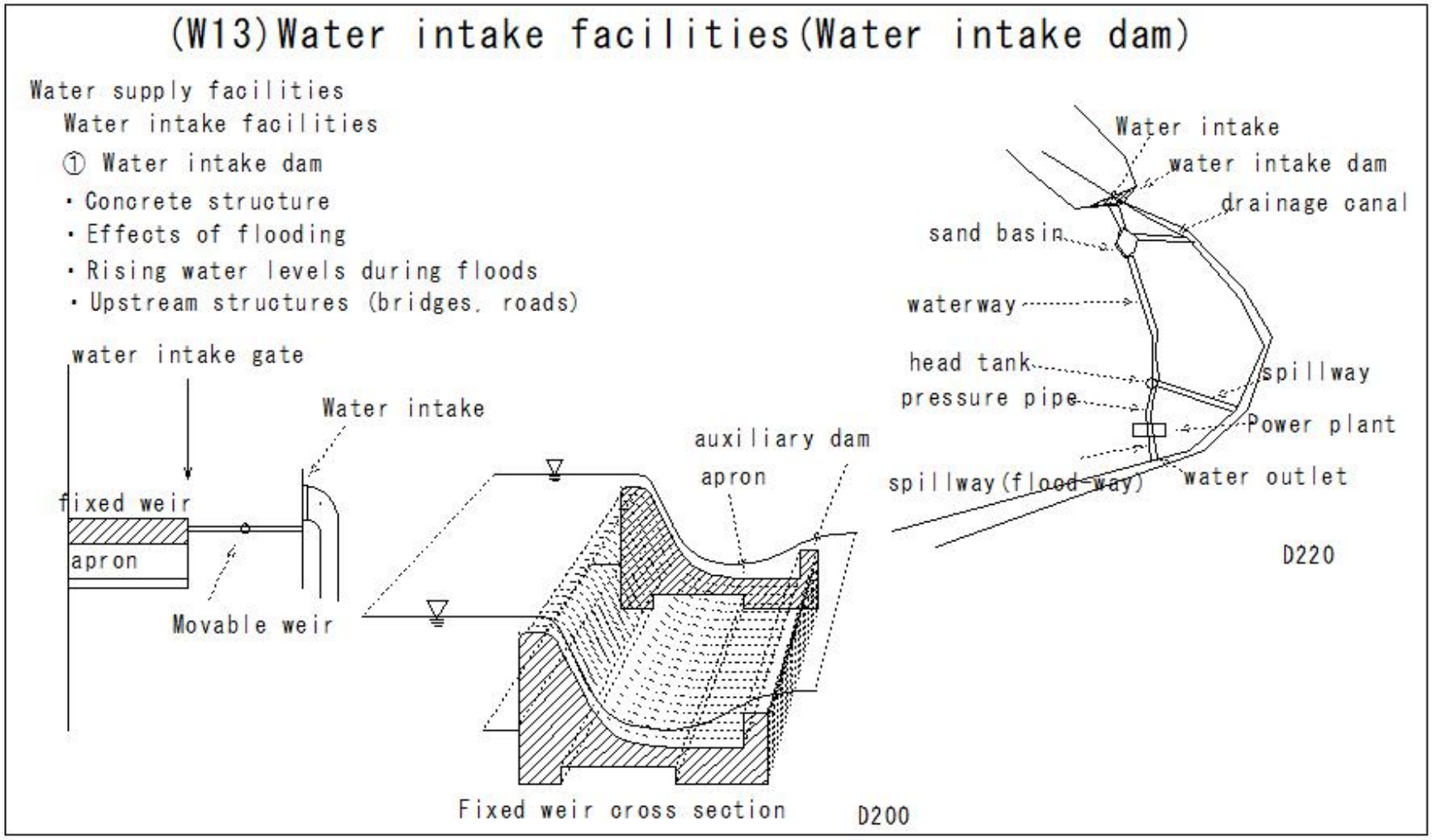
③ Underground water: Change in the center of the river flow; Lowering of the riverbed: Dry water volume decreases; Water cannot be drawn



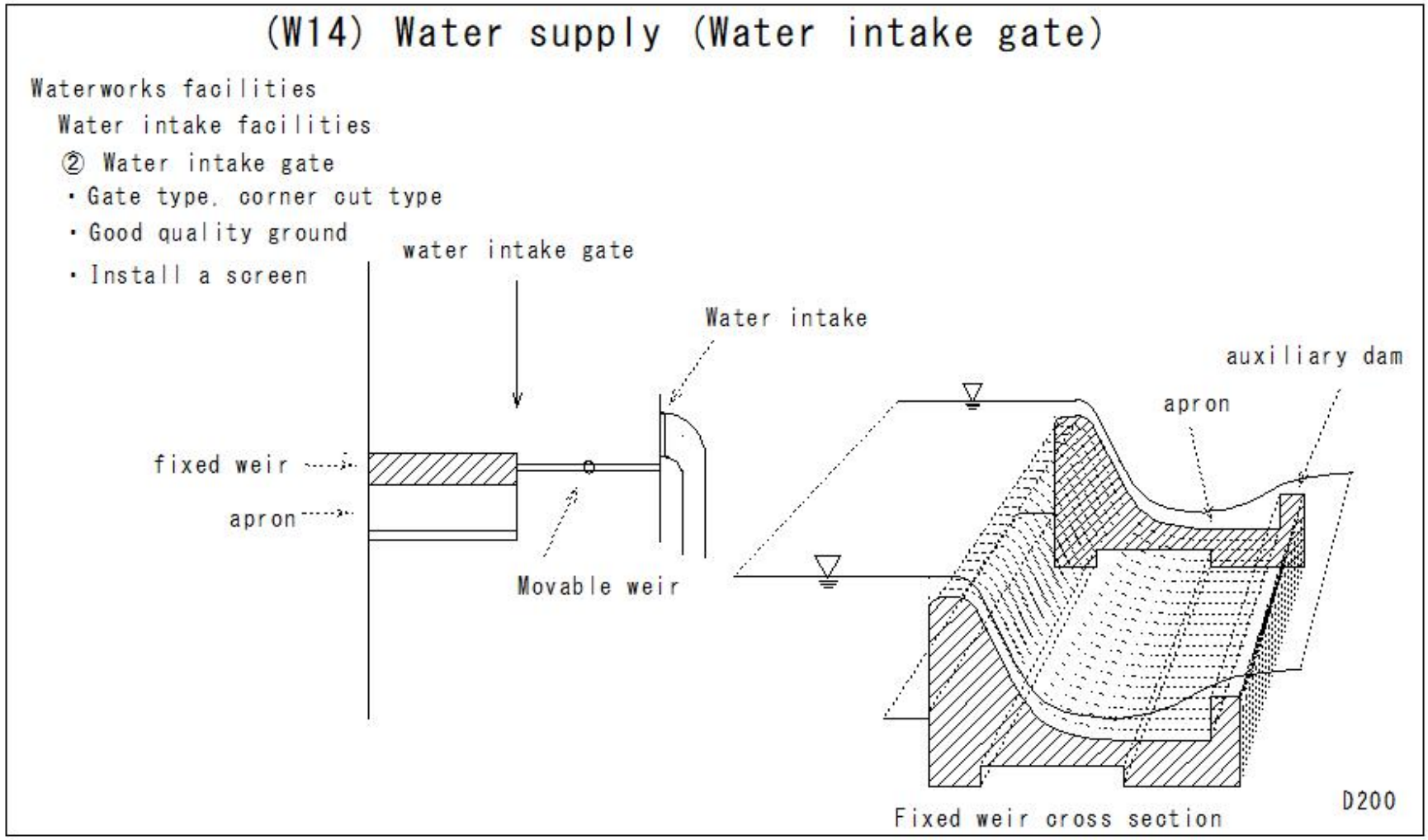


R609

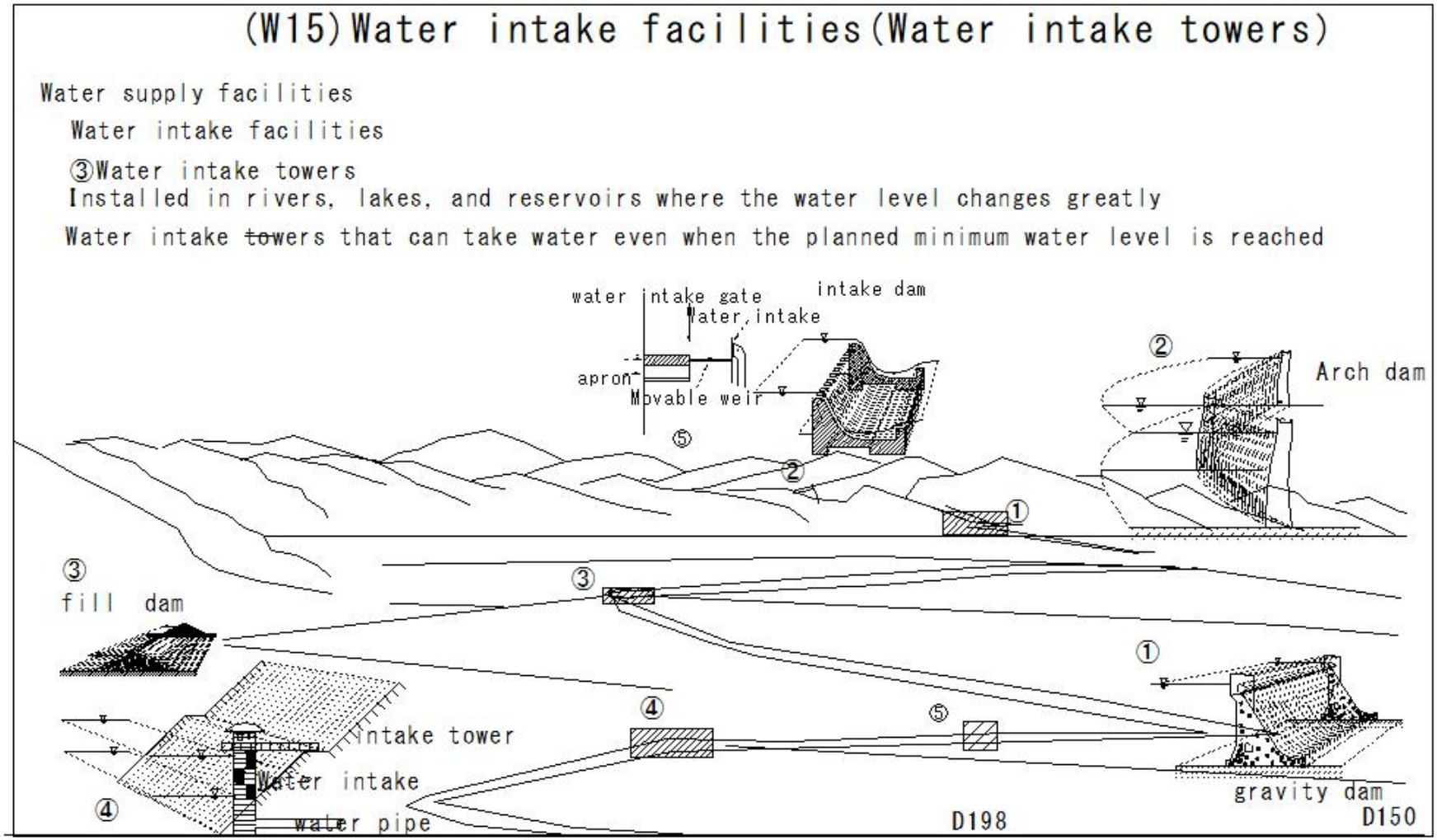
(W13)Water intake facilities(Water intake dam）



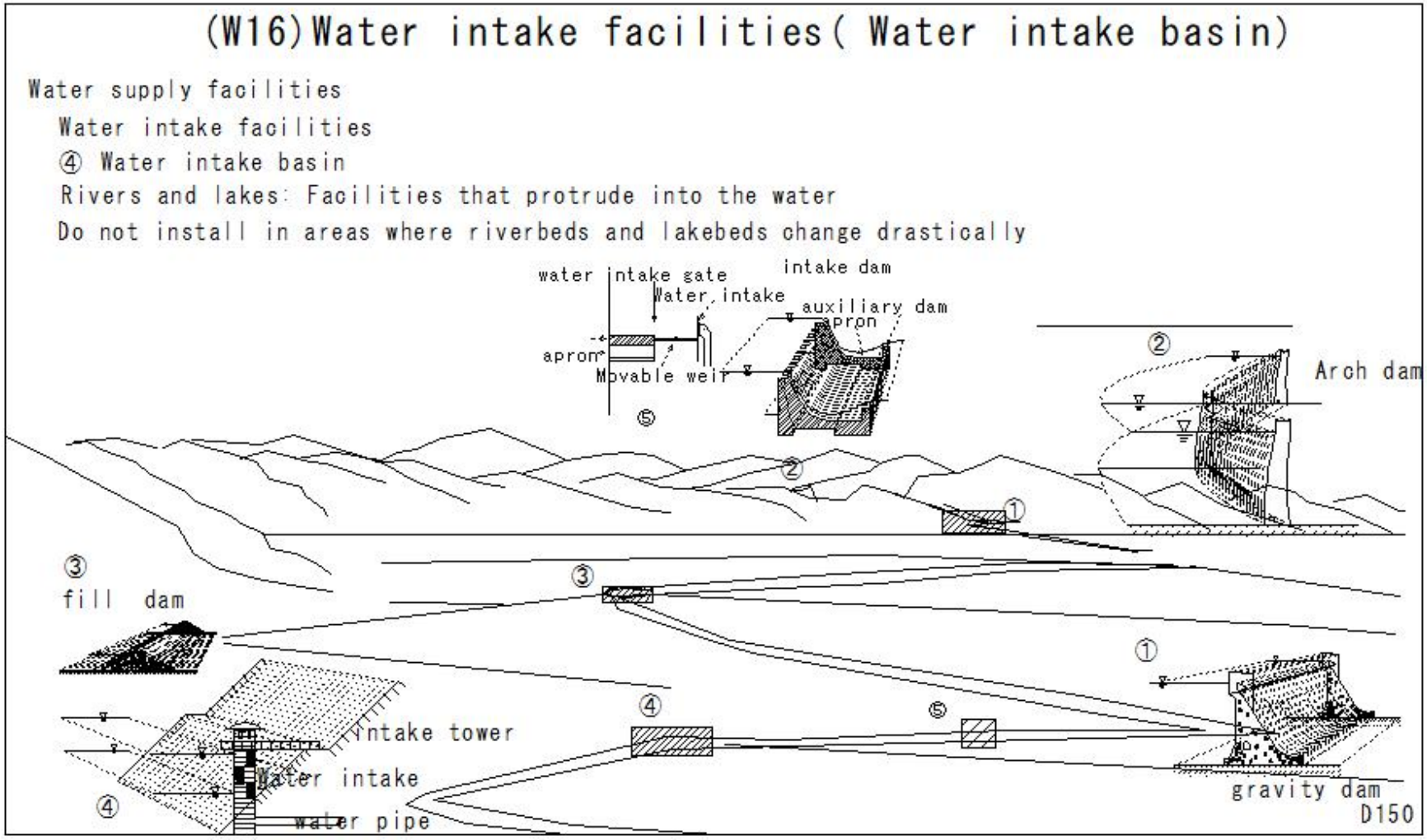
(W14)Water intake facilities(Water intake gate）



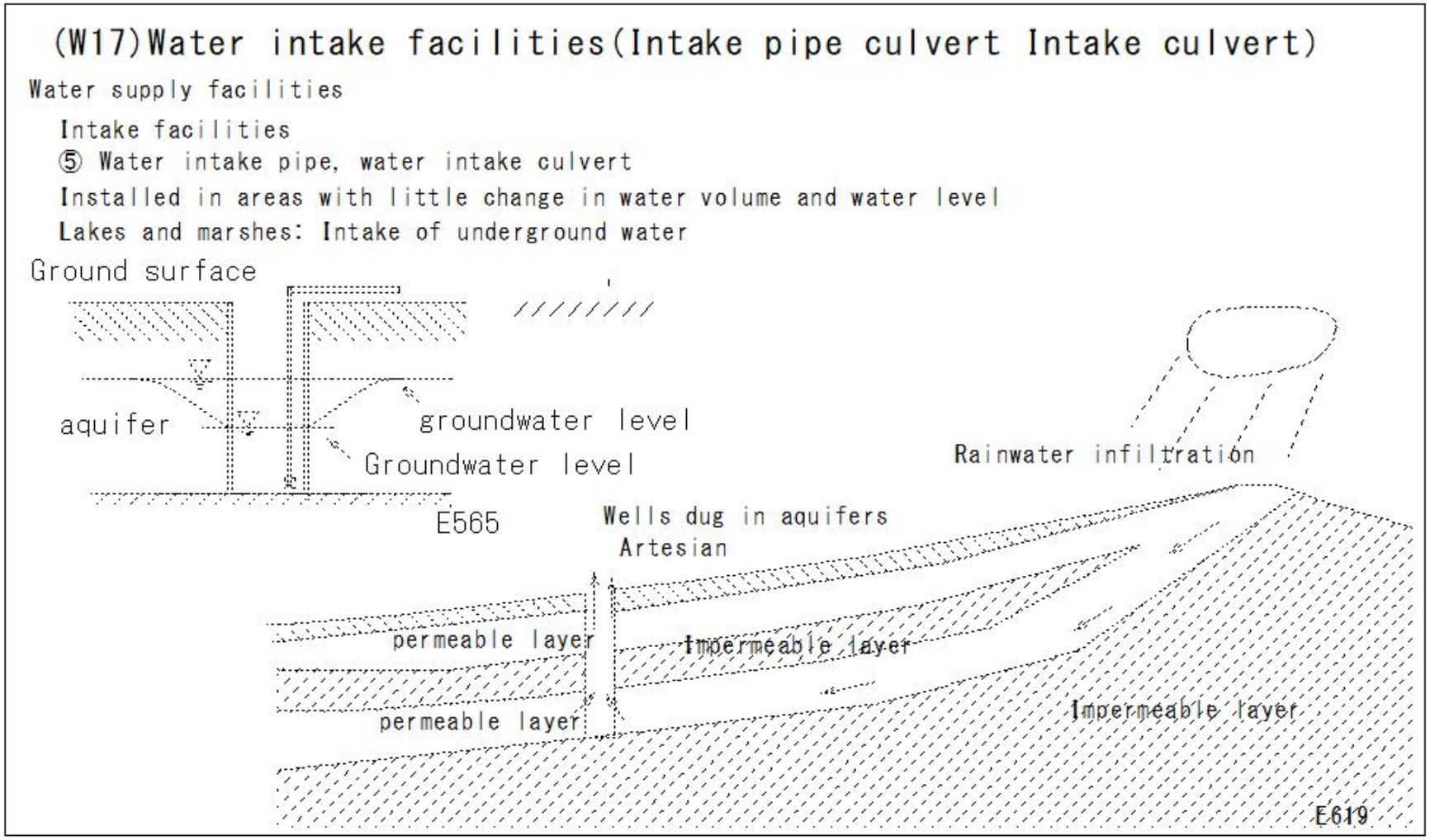
(W15)Water intake facilities(Water intake towers）



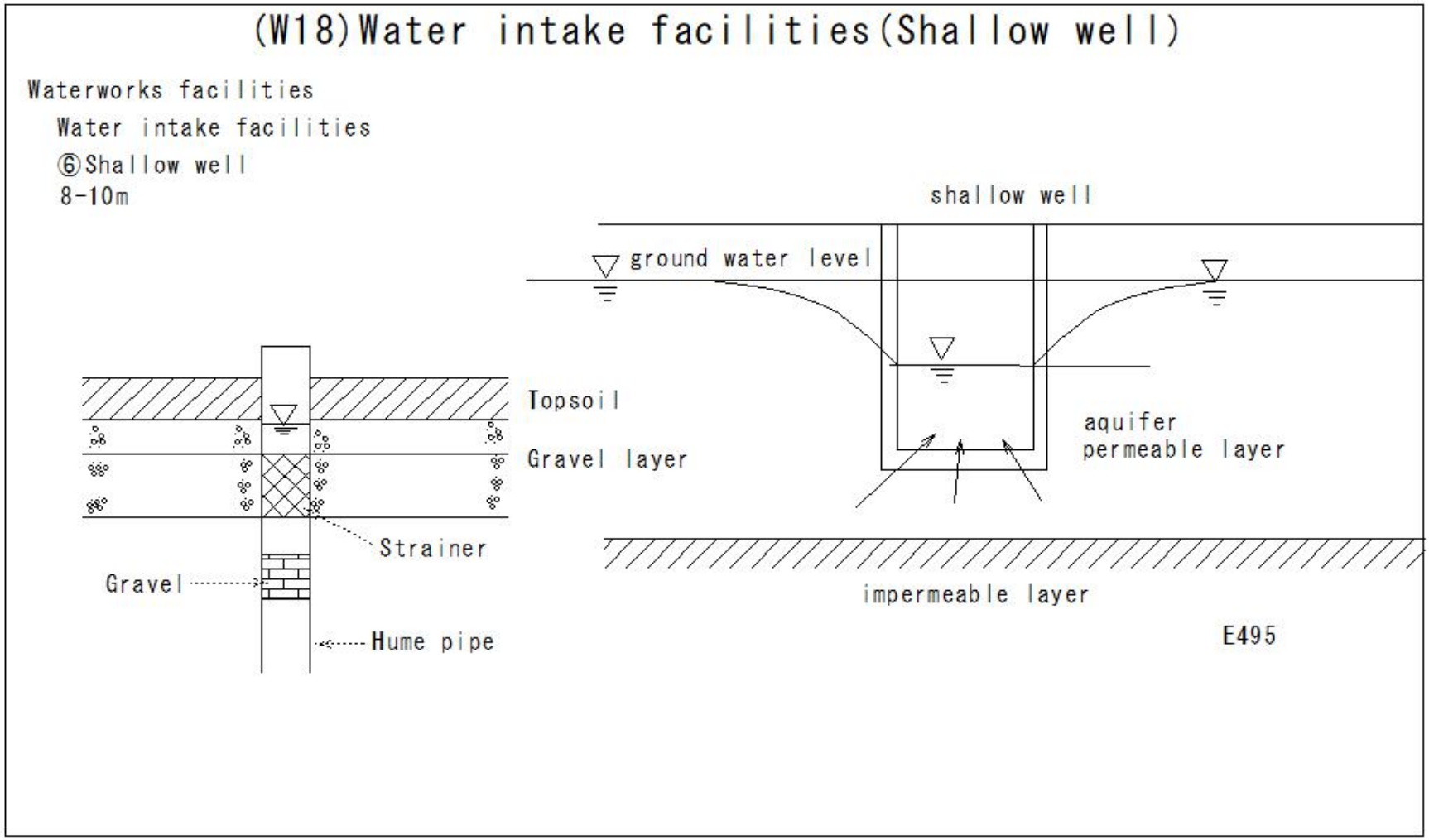
(W16)Water intake facilities(Water intake basin）



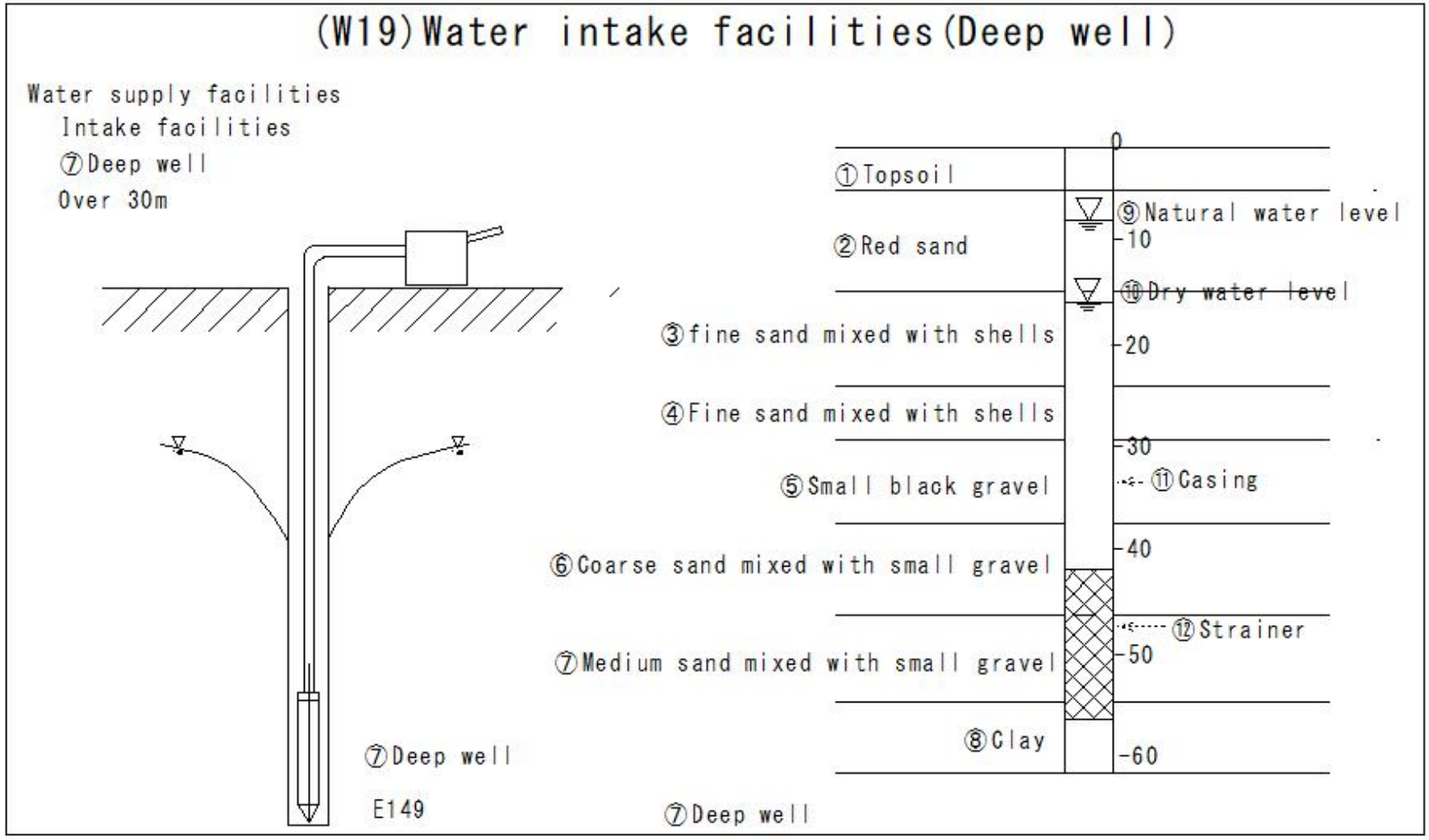
(W17)Water intake facilities(Intake pipe culvert Intake culvert)



(W18)Water intake facilities(Shallow well）



(W19)Water intake facilities(Deep well)



(W20)Water intake facilities(Water storage facilities）

(W20)Water intake facilities(Water storage facilities)

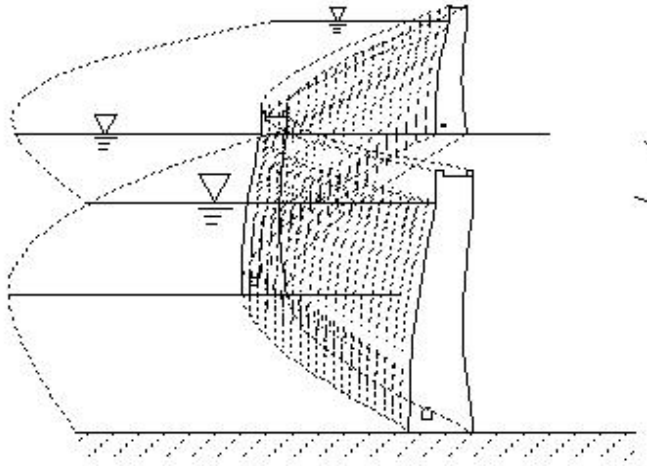
Water supply facilities

Water storage facilities

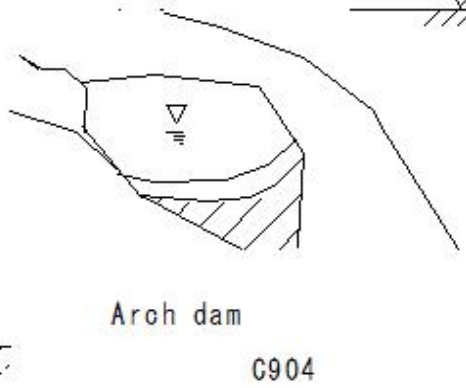
- Dams and lakes
- Dams: dams for water supply only

Multipurpose dams

- Selected based on topography, geology, hydraulic conditions, etc.

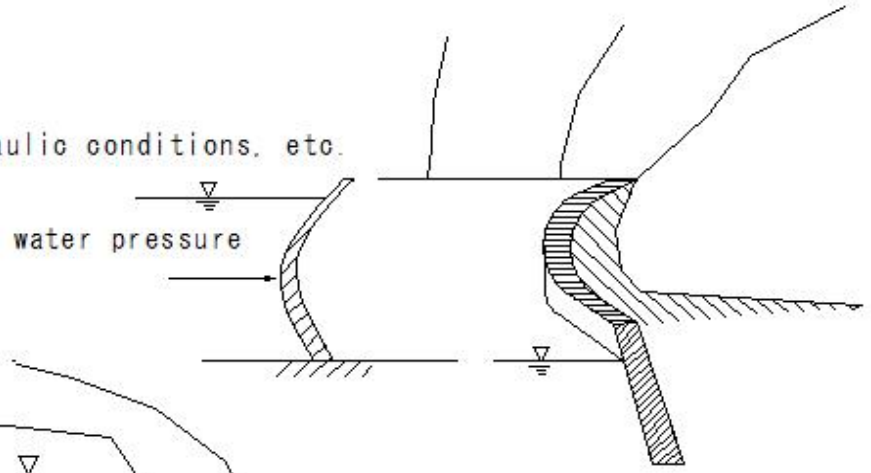


D3



Arch dam

C904



Arch dam

C1233

D155

(W21)Water intake facilities(Water conveyance）

(W21)Water intake facilities(Water conveyance)

Water supply facilities

Water conveyance facilities

Conducting raw water to a water purification plant

Water conveyance facilities:

Water conveyance pipes, pumps

Water conveyance

Underground type (covered conduit)

Surface type (open conduit)

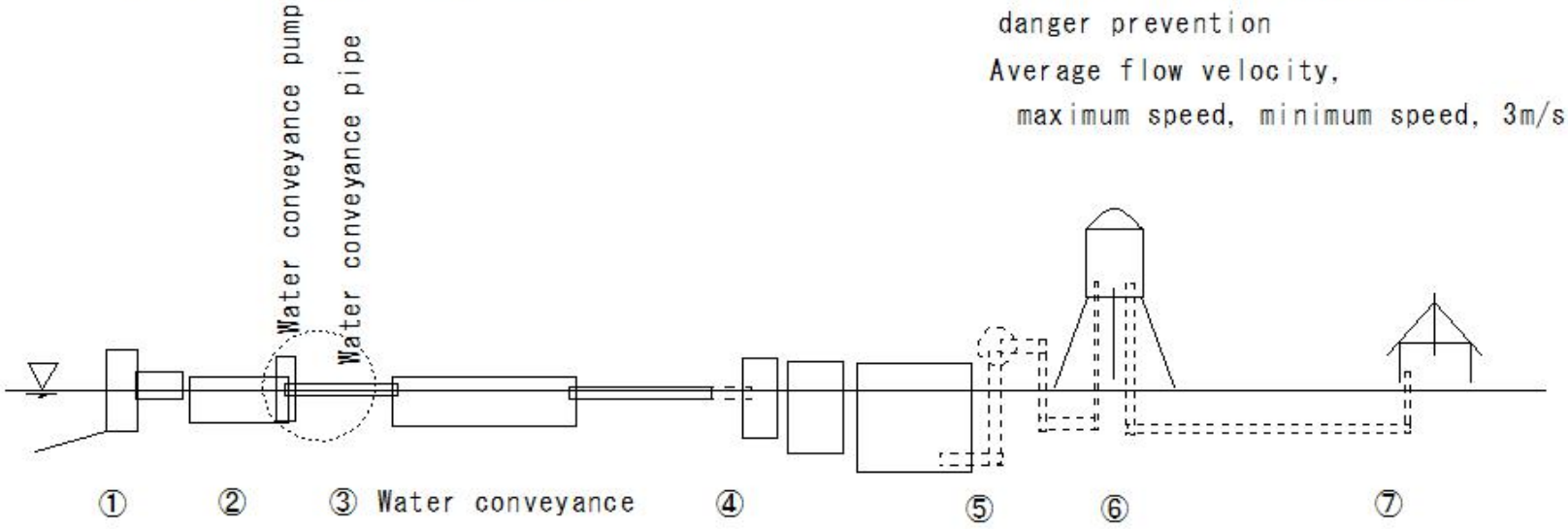
In the case of open conduits,

water pollution prevention,

danger prevention

Average flow velocity,

maximum speed, minimum speed, 3m/s



T5

(W22)Water intake facilities(Water conveyance pipes）

(W22)Water intake facilities(Water conveyance pipes)

Water supply facilities

Water conveyance facilities

Conveying raw water to the water purification plant

Water conveyance facilities: Water conveyance pipes, pumps

②Water conveyance pipes

withstand internal and external pressure

①Materials

Water conveyance pipe types

・Cast iron pipes

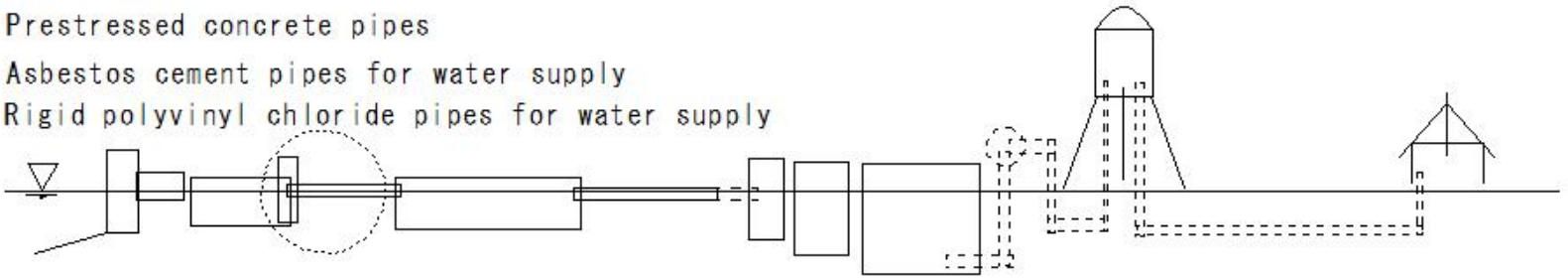
・Ductile cast iron pipes

・Steel pipes

・Prestressed concrete pipes

・Asbestos cement pipes for water supply

・Rigid polyvinyl chloride pipes for water supply



③ Water conveyance

Water conveyance pump

Water conveyance pipe

(W23)Water intake facilities(Water conveyance pipes）

(W23)Water intake facilities(Water conveyance pipes)

Water supply facilities

Water conveyance facilities

②Pipe diameter and flow rate(discharge) formula

Low water level at the start point and high water level at the end point: Considering hydraulic gradient

Hazen Williams formula

$$V=kCR^{0.63}S^{0.54}$$

V: flow velocity

k: conversion factor for each unit system
(k = 1.318 for US customary units, k = 0.849 for SI units)

C: flow coefficient

R: hydraulic radius

S: hydraulic gradient (head loss per length of pipe, i.e. hf/L)

(W24)Water intake facilities(Water conveyance facilities-Pipelines）

(W24)Water intake facilities(Water conveyance facilities-Pipelines)

Water supply facilities

Water conveyance facilities

③Pipelines

①Public roads or water supply land

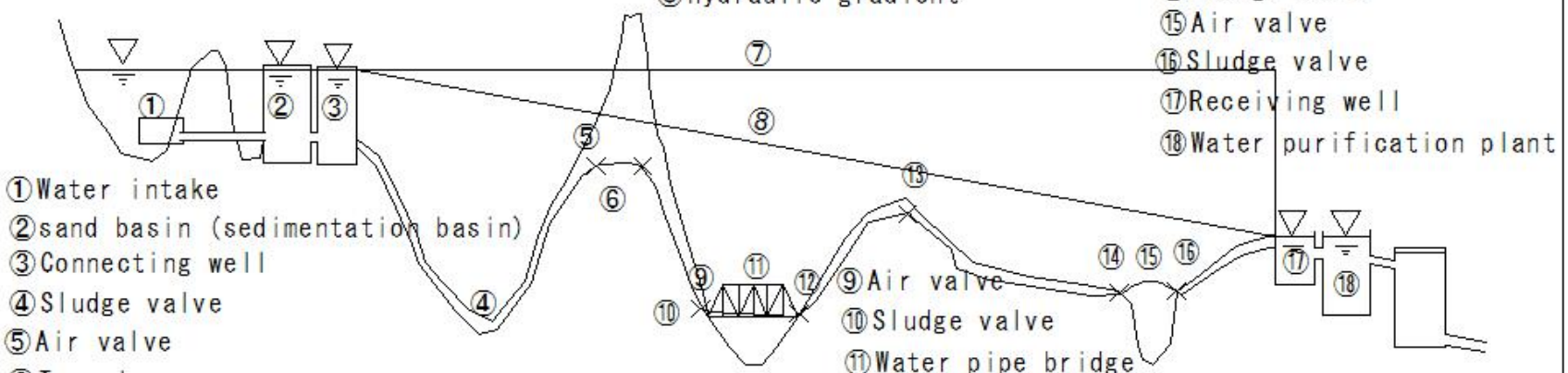
②Avoid sudden bends

③Safety valves and pressure regulating tanks: Deal with water hammer

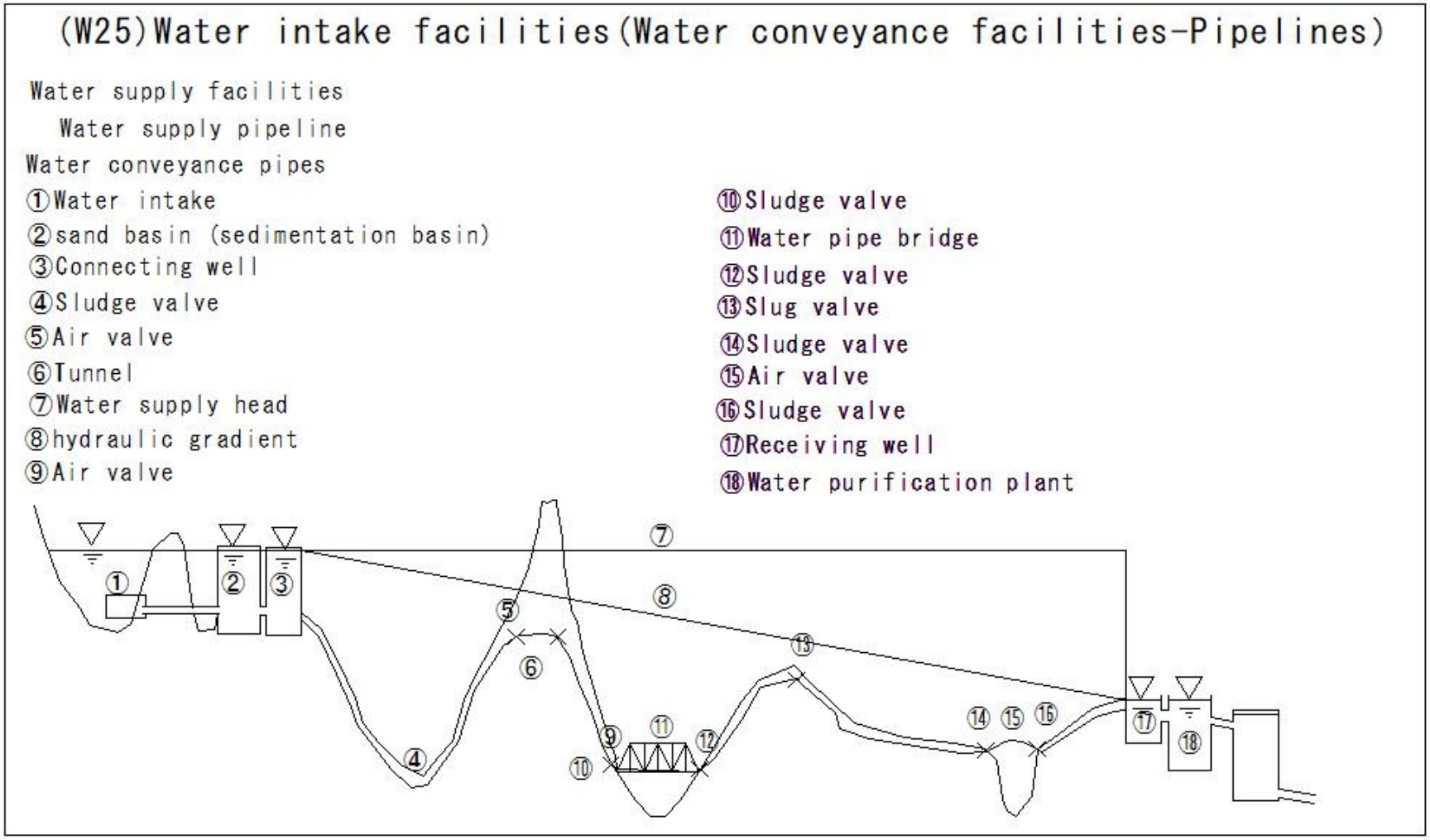
④Air valves in convex areas where air can easily accumulate

Install sludge valves in concave areas where sediment can easily accumulate

⑤Accident response: 2 pipes, install connecting pipes at key points



(W25)Water intake facilities(Water conveyance facilities-Pipelines）



(W26)Water intake facilities(Water conveyance facilities-Pipelines）

(W26)Water intake facilities(Water conveyance facilities-Pipelines)

Water supply facilities

Water conveyance (supply) facilities

Water conveyance pipes

④ Burial depth

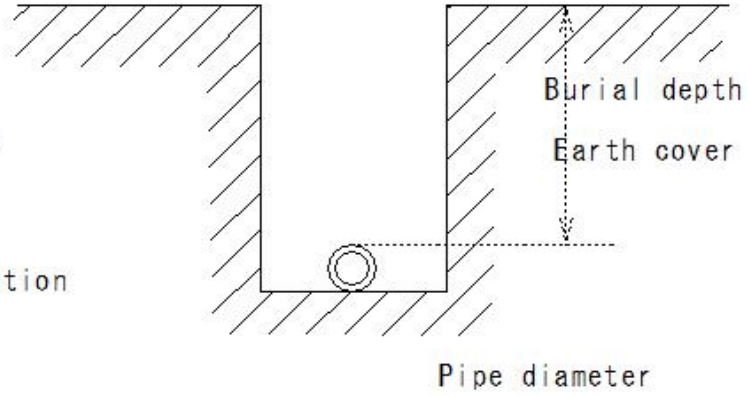
① Public roads: Agreement with road administrator

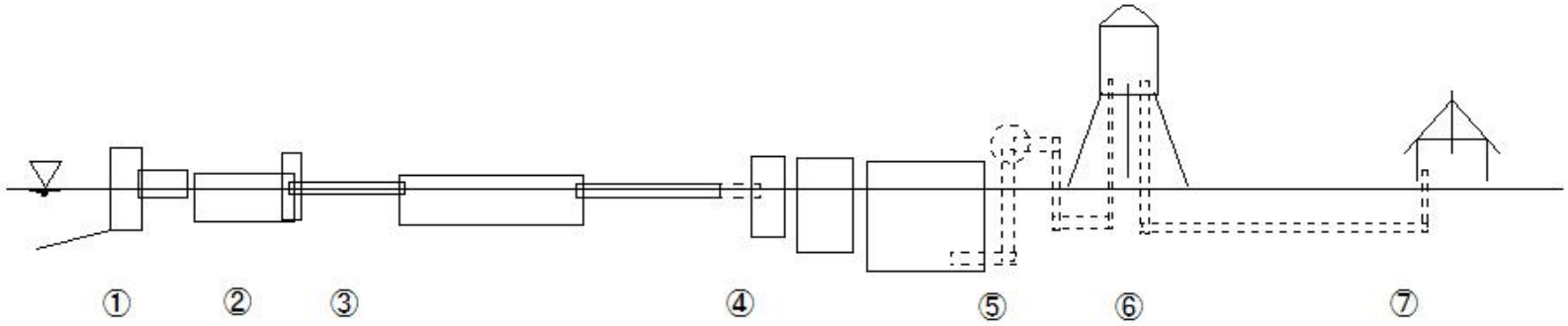
② Pipe diameter 900mm or less: 120cm or more

Pipe diameter 900mm or more: 150cm or more

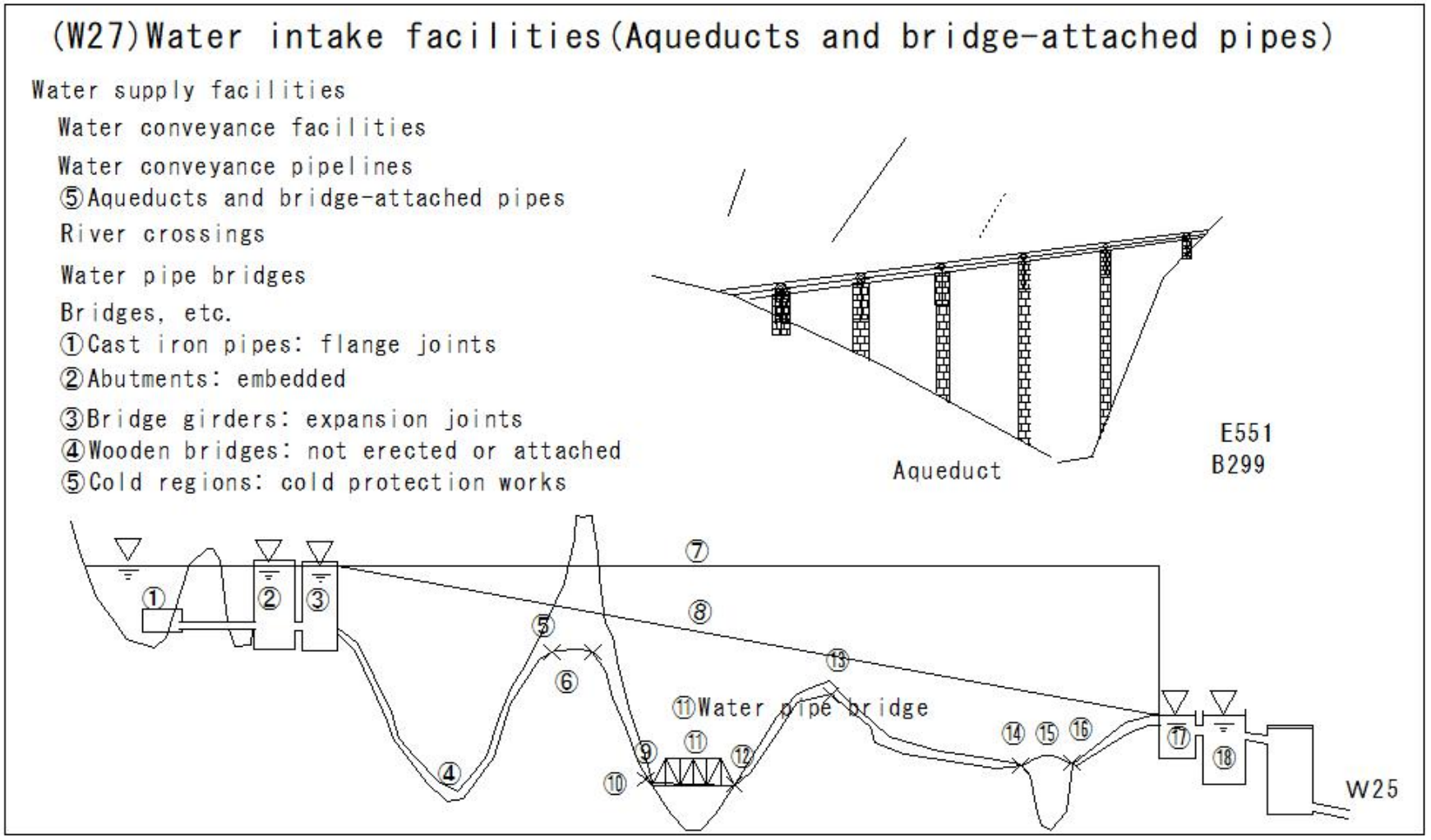
③ Burial depth - shallow - concrete slab installation

④ Cold regions: greater than freezing depth





(W27)Water intake facilities(Aqueducts and bridge-attached pipes）



(W28)Water intake facilities(Plumber)

(W28)Water intake facilities(Plumber)

Waterworks facilities

Water supply facilities

Water supply pipelines

⑥Plumber

・Mechanical joint cast iron pipe

・Welded joint steel pipe

・Welded joint steel pipe

・Installation direction: Pipe facing higher than the receiving port

Pipe support method

①Flat bottom bearing: Small diameter pipe Pipe bottom: Sand as cushion

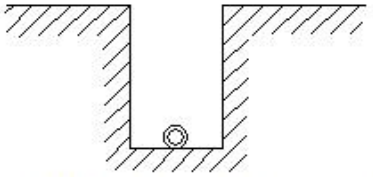
②Circular arc bearing: Thin steel pipe

Large diameter cast iron pipe

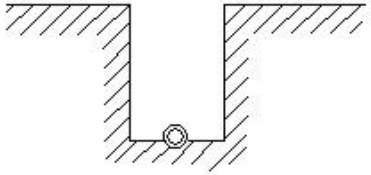
Areas with good geology

③Pine sheet pile leveling bearing

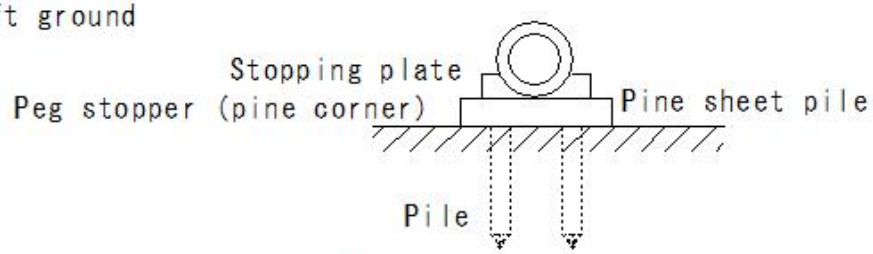
Areas with soft ground



①Flat bottom bearing



②Circular arc bearing



③Pine sheet pile leveling bearing

(W29)Water supply facilities(Water purification facilities)

(W29)Water supply facilities(Water purification facilities)

Water supply facilities

Water purification facilities

River water, groundwater - purified to drinkable water

・Complies with tap water quality standards

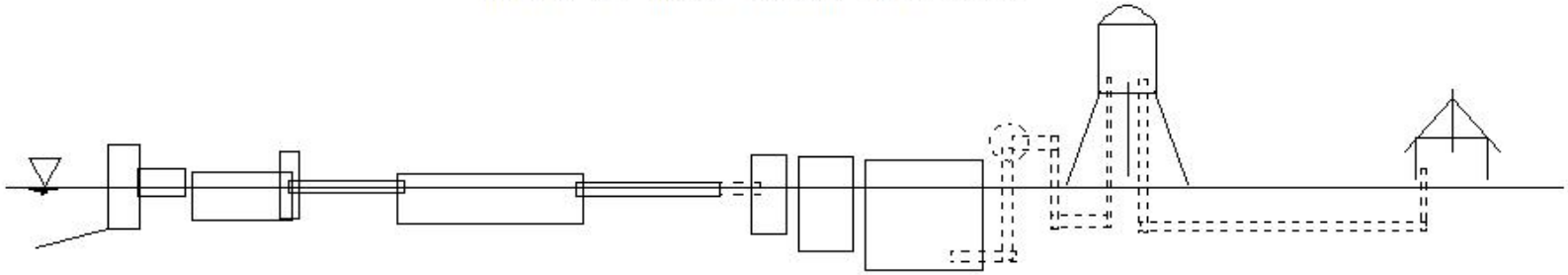
①Raw water quality: coliform bacteria (100?L, MPN) 500 or less

General bacteria (1?l) 500 or less

②Other than ①, set up facilities for sedimentation, filtration, and disinfection

③Large amount of impurities in raw water: impurity removal: water purification facilities

Layout of water supply facilities



④ Water purification

Sedimentation basin

filtration basin

Chlorine disinfection room

Water purification area

W5

(W30)Water supply facilities(Water purification facilities)

(W30)Water supply facilities(Water purification facilities)

Water supply facilities

Location, arrangement, and structure of water purification facilities

① Water purification plant: Sanitary environment

② Avoid low-lying areas

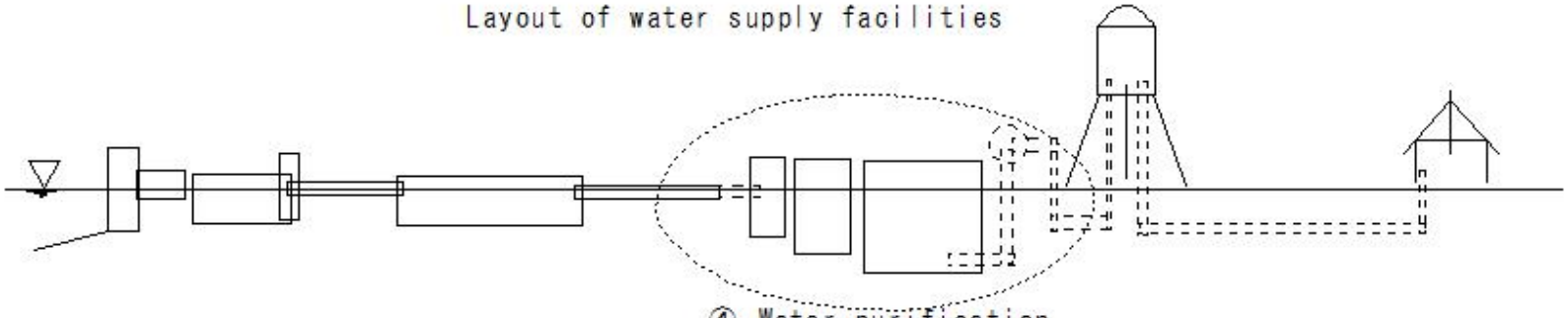
③ No obstruction to drainage from sedimentation ponds, filtration ponds, etc.

④ Filtration: No sewage, rainwater, or insects enter purified water

⑤ Toilets, sewage pits, and wastewater dumps: No sewage leakage

Location: At least 15m away from sedimentation ponds, filtration areas, purified water ponds, and drainage ponds

Layout of water supply facilities



④ Water purification

Sedimentation basin

filtration basin

Chlorine disinfection room

Water purification area

W5

(W31)Water supply facilities(Water purification facilities)

(W31)Water supply facilities(Water purification facilities)

Water supply facilities

Location, arrangement, and structure of water purification facilities

Slow sand filtration

Rapid sand filtration

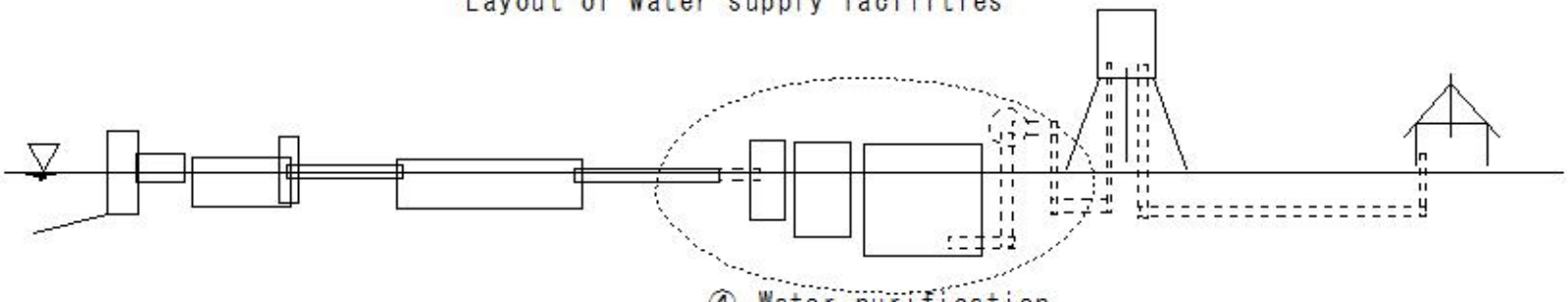
Slow sand filtration

①Annual average turbidity of raw water: 10 degrees or less

②Biochemical oxygen demand (BOD) 2 ppm or less

③Coliform bacteria (100 ml, MPN) 1000 or less

Layout of water supply facilities



④ Water purification

Sedimentation basin

filtration basin

Chlorine disinfection room

Water purification area

W5

(W32)Water supply facilities(Slow sand filtration）

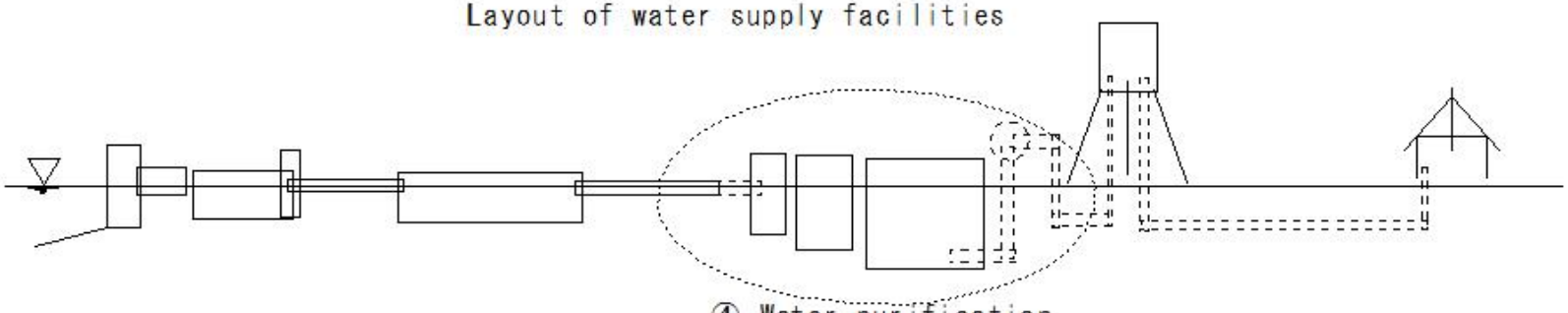
(W32)Water supply facilities(Slow sand filtration)

Water supply facilities

Location, arrangement, and structure of water purification facilities

① Slow sand filtration

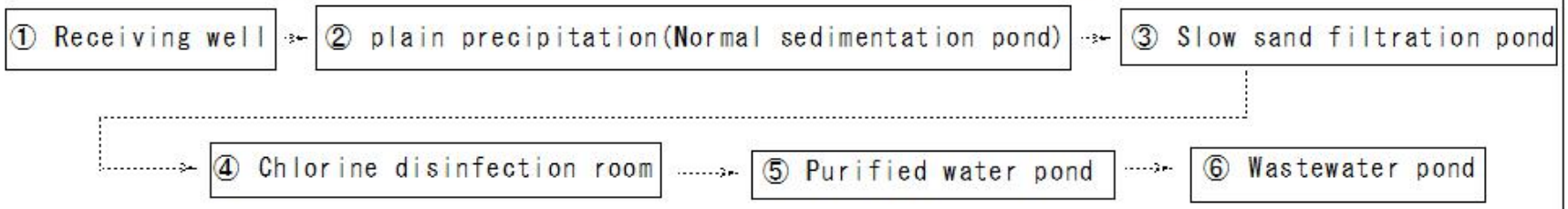
Layout of water supply facilities



④ Water purification
Sedimentation basin
filtration basin
Chlorine disinfection room
Water purification area

W5

Flow sheet of slow sand filtration



(W33)Water supply facilities(Rapid sand filtration）

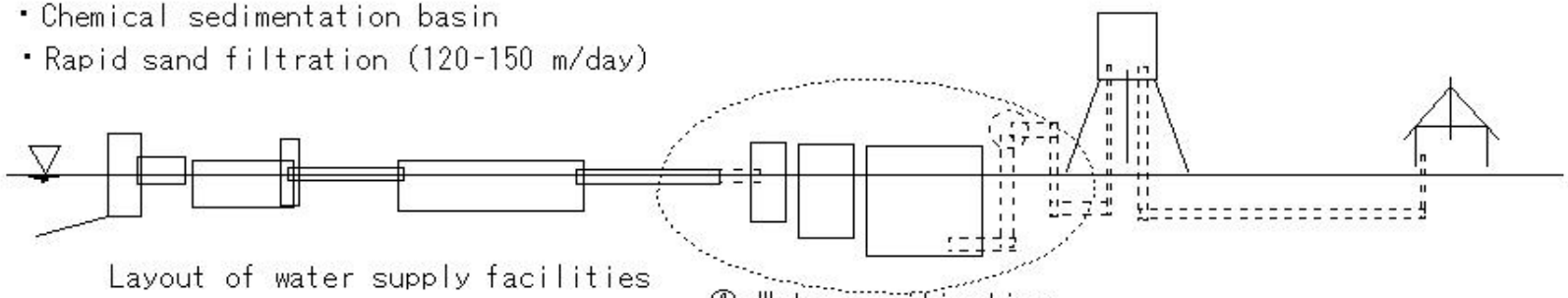
(W33)Water supply facilities(Rapid sand filtration)

Water supply facilities

Location and arrangement of water purification facilities

②Rapid sand filtration

- Chemical sedimentation basin
- Rapid sand filtration (120-150 m/day)



Layout of water supply facilities

④ Water purification

Sedimentation basin

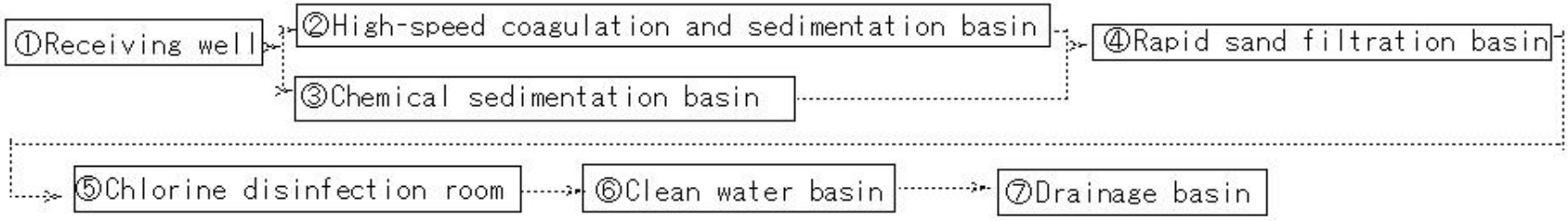
filtration basin

Chlorine disinfection room

Water purification area

W5

Rapid filtration flow sheet



(W34)Water supply facilities(Comparison between rapid and slow sand filtration)

(W34)Water supply facilities(Comparison between rapid and slow sand filtration)

Water supply facilities

Location, arrangement, and structure of water purification facilities

②Comparison between rapid and slow sand filtration

Item	Method	
	Rapid sand filtration	Slow sand filtration
①Filtration speed	⑦100-150 m/day	⑬4-5 m/day
②Treatment method	⑧Pretreatment and physical filtration	⑭Physical filtration and biochemical action
③Maintenance costs	⑨Expensive	⑮cheap
④Site area	⑩Small area	⑯large site
⑤Raw water turbidity	⑪Appropriate in case of temperature is above 10 degrees	⑰Appropriate in case of temperature is below 10 degrees
⑥Management technology	⑫Requires advanced technology	⑱Normal

(W35)Water supply facilities(water purification facilities）

(W35)Water supply facilities(water purification facilities)

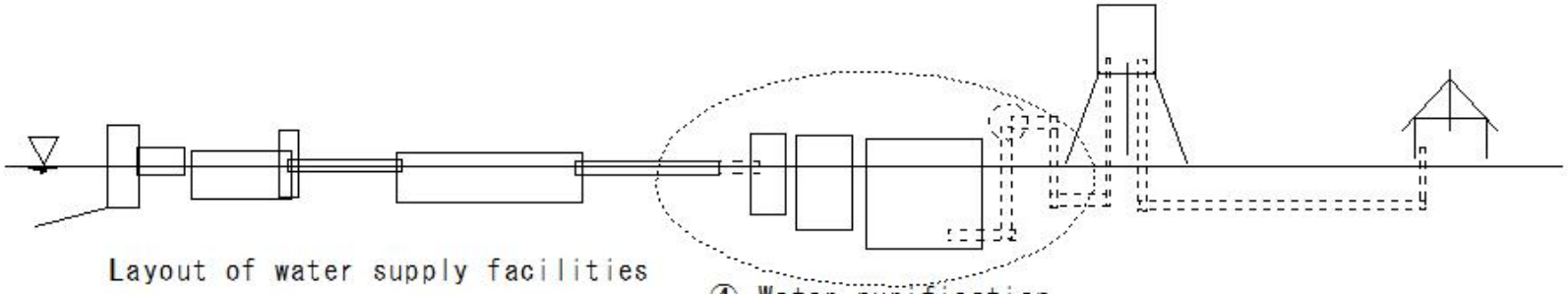
Water supply facilities

Location, arrangement, and structure of water purification facilities

③Disinfection

All disinfection uses chlorine

Chlorine agent: liquid chlorine, bleaching powder



Layout of water supply facilities

④ Water purification

Sedimentation basin

filtration basin

Chlorine disinfection room

Water purification area

W5

(W36)Water supply facilities(water purification facilities）

(W36)Water supply facilities(water purification facilities)

Water supply facilities

Location, arrangement, and structure of water purification facilities

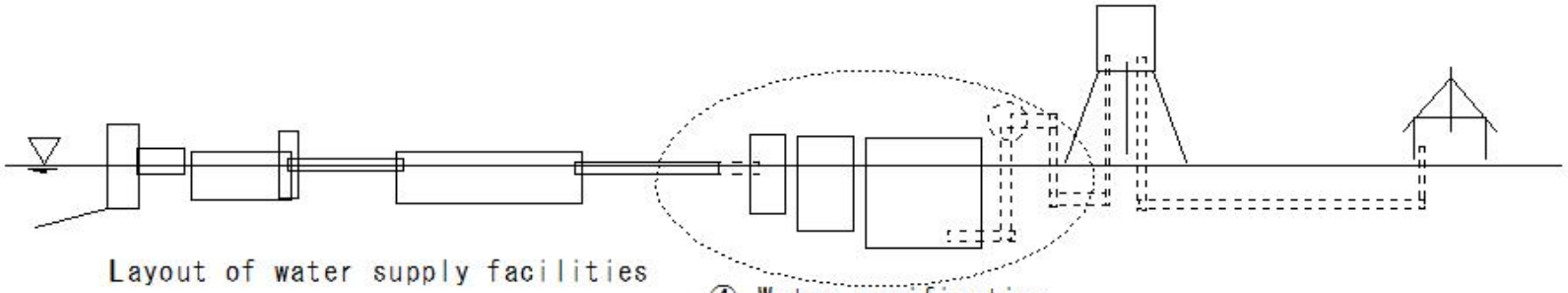
④Other treatments

①Pre-chlorination

②pH adjustment

③Aeration

Supplying oxygen from the air to the water



Layout of water supply facilities

④ Water purification

Sedimentation basin

filtration basin

Chlorine disinfection room

Water purification area

W5

(W37)Water supply facilities(water purification facilities）

(W37)Water supply facilities(water purification facilities)

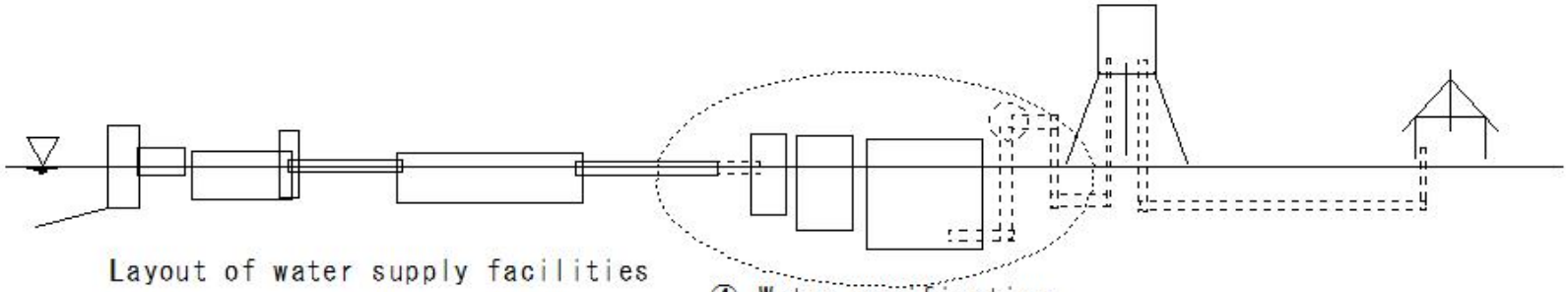
Water supply facilities

Location, arrangement, and structure of water purification facilities

⑤Removal of iron and manganese

Iron: Bad odor, water turns red

Manganese: Causes black water



Layout of water supply facilities

④ Water purification

Sedimentation basin

filtration basin

Chlorine disinfection room

Water purification area

W5

(W38)Water supply facilities(water purification facilities）

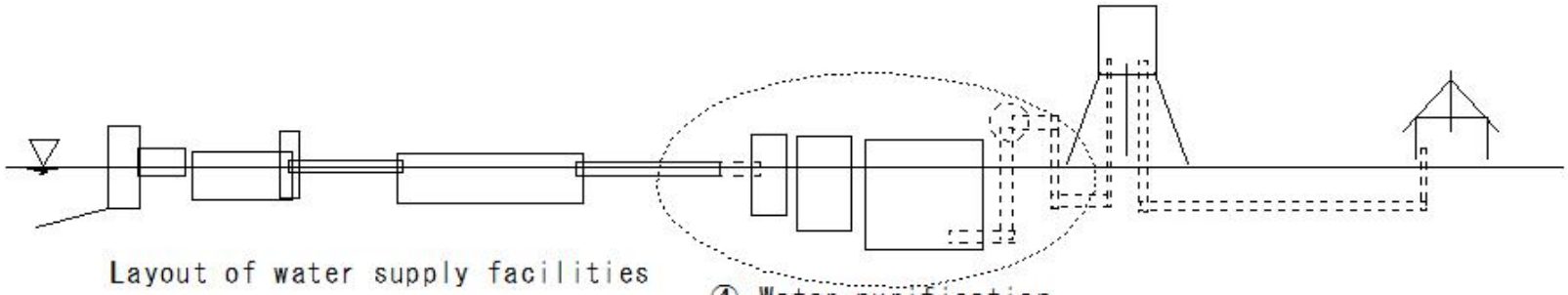
(W38)Water supply facilities(water purification facilities)

Water supply facilities

Location, arrangement and structure of water purification facilities

⑥Activated carbon treatment

⑦Ozone treatment



Layout of water supply facilities

④ Water purification

Sedimentation basin

filtration basin

Chlorine disinfection room

Water purification area

W5

(W39)Water supply facilities(water purification facilities-conveyance)facilities）

(W39)Water supply facilities(water purification facilities-conveyance)facilities)

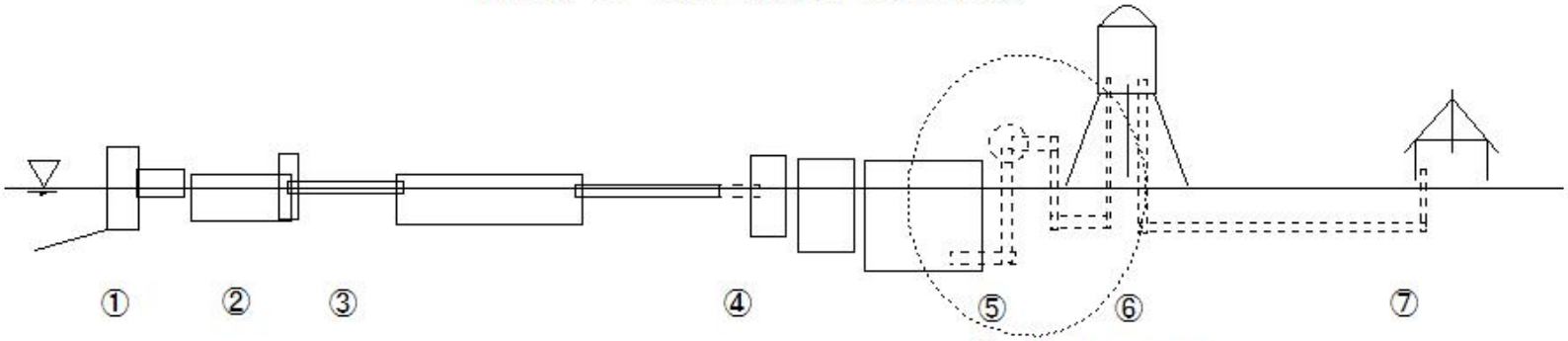
Water supply facilities

Location, arrangement, and structure of water purification facilities

Water supply (water-conveyance)facilities

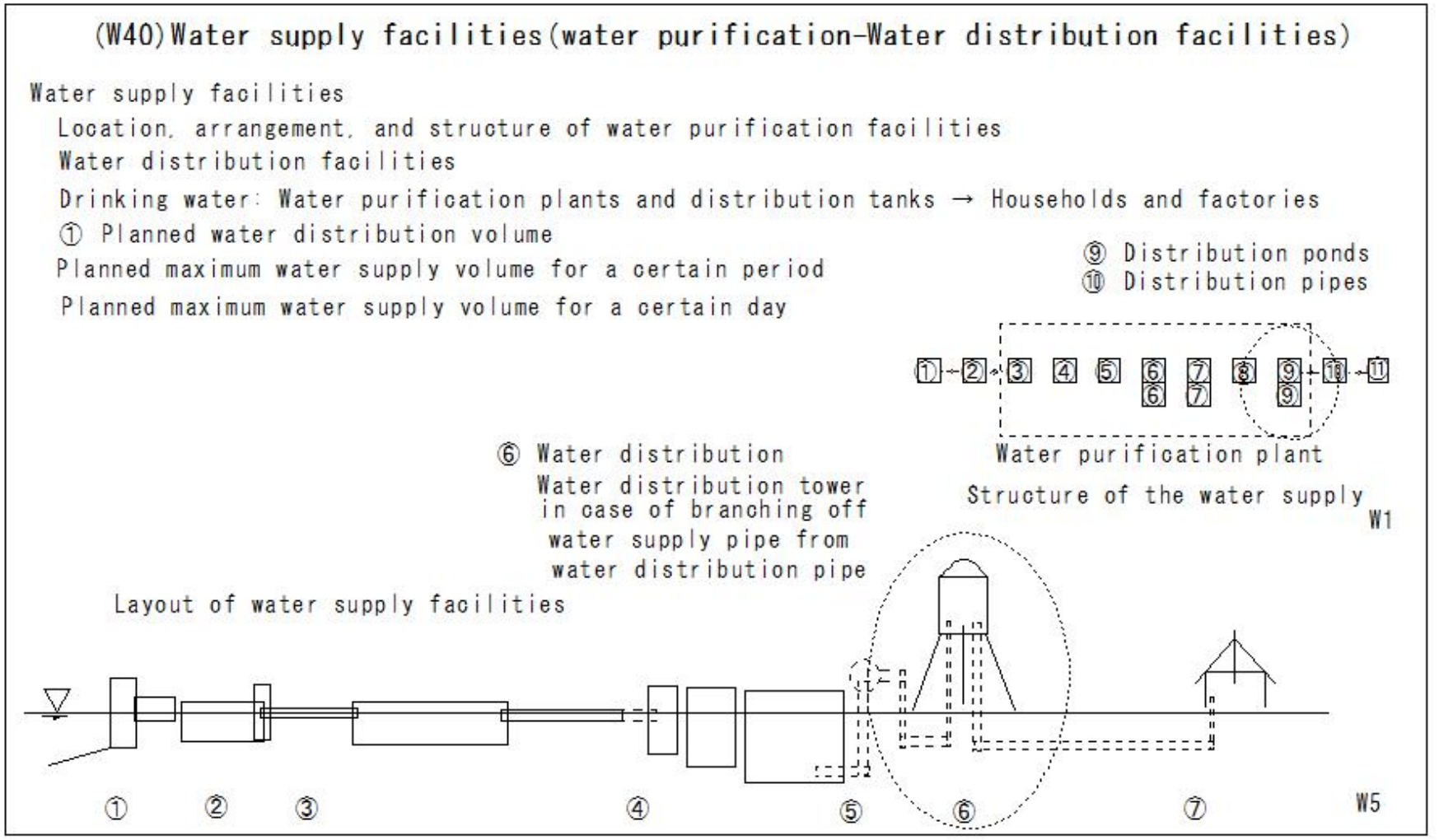
- Water purification facilities → Purified water → Water reservoir
- Water pipes
- Water volume calculation: Planned maximum daily water supply (standard)
- Water supply channel: Pipe type, diameter, and channel - same as water conveyance facilities

Layout of water supply facilities

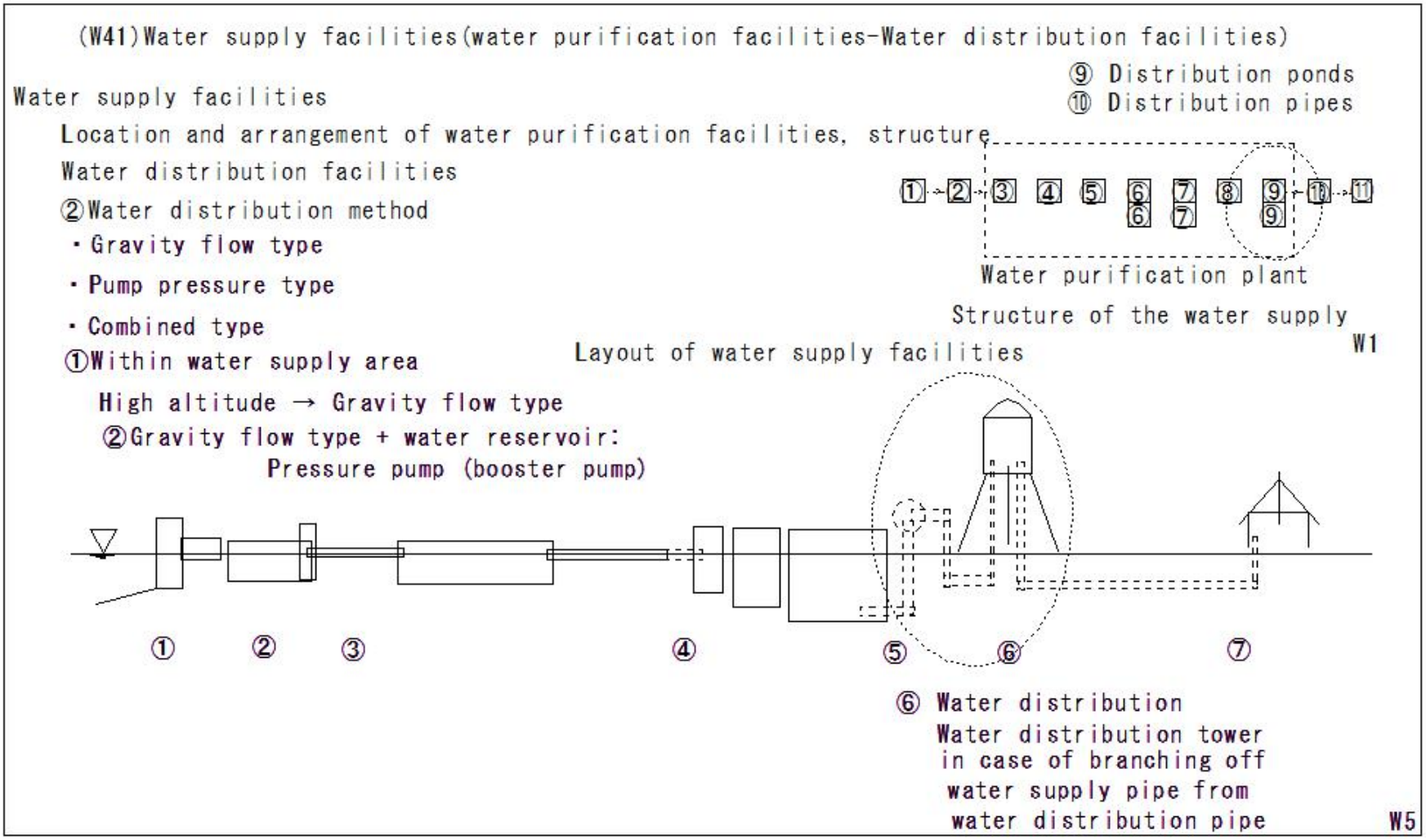


⑤ Water supply
Water conveyance pump
Water conveyance pipe

(W40)Water supply facilities(water purification facilities-Water distribution facilities)



(W41)Water supply facilities(water purification facilities-Water distribution facilities)



(W42)Water supply facilities(Water distribution facilities)

(W42)Water supply facilities(Water distribution facilities)

Water supply facilities

Position and arrangement of water purification facilities, structure

Water distribution facilities

③ Water distribution reservoir

・Storage of purified water

・Role of adjusting water distribution

① Structure

・Prevention of algae growth, cover to prevent rainwater from entering

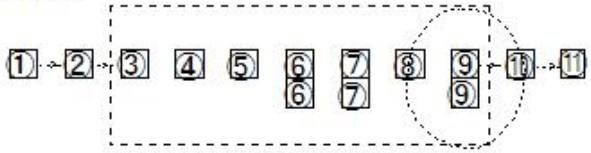
・Pollution prevention → Solid structure

・Insulation device

・Cleaning, interior painting, repainting → 2 or more reservoirs

⑨ Distribution ponds

⑩ Distribution pipes



Water purification plant

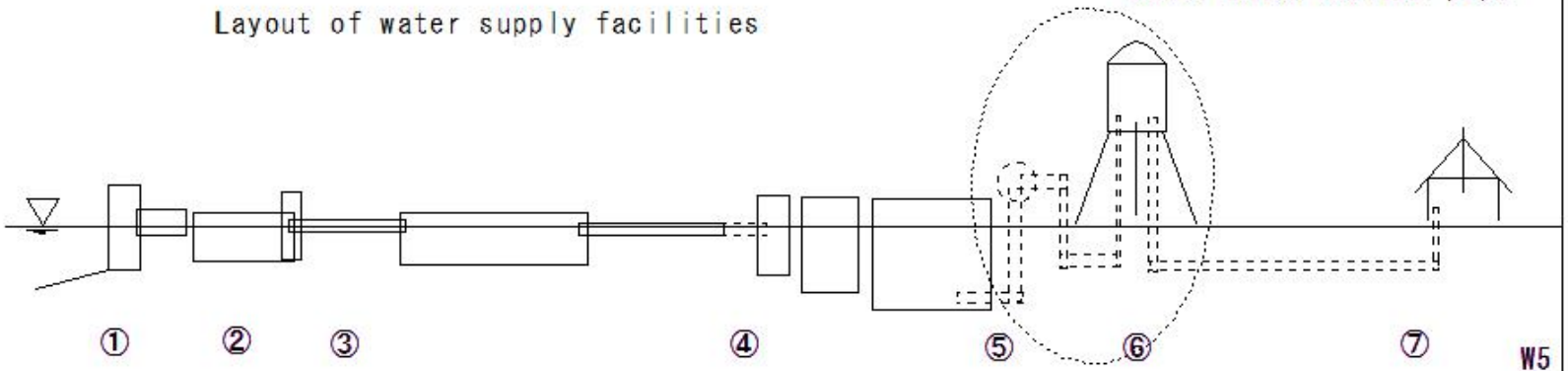
Structure of the water supply

W1

⑥ Water distribution

Water distribution tower in case of branching off water supply pipe from water distribution pipe

Layout of water supply facilities



W5

(W43)Water supply facilities(Water distribution facilities)

(W43)Water supply facilities(Water distribution facilities)

Water supply facilities

Position and arrangement of water purification facilities

Water distribution facilities

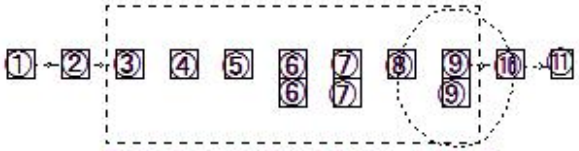
③ Water distribution reservoir

- Stores purified water
- Role of adjusting water distribution

② Position and height

- Center of water supply area
- Height that ensures dynamic water pressure
- Within water supply area → Large difference in elevation → Water distribution reservoirs are set up in 2-3 water supply areas
- Effective water volume: Standard is 8-12 hours' worth of the planned maximum daily water supply volume

⑨ Distribution ponds
⑩ Distribution pipes



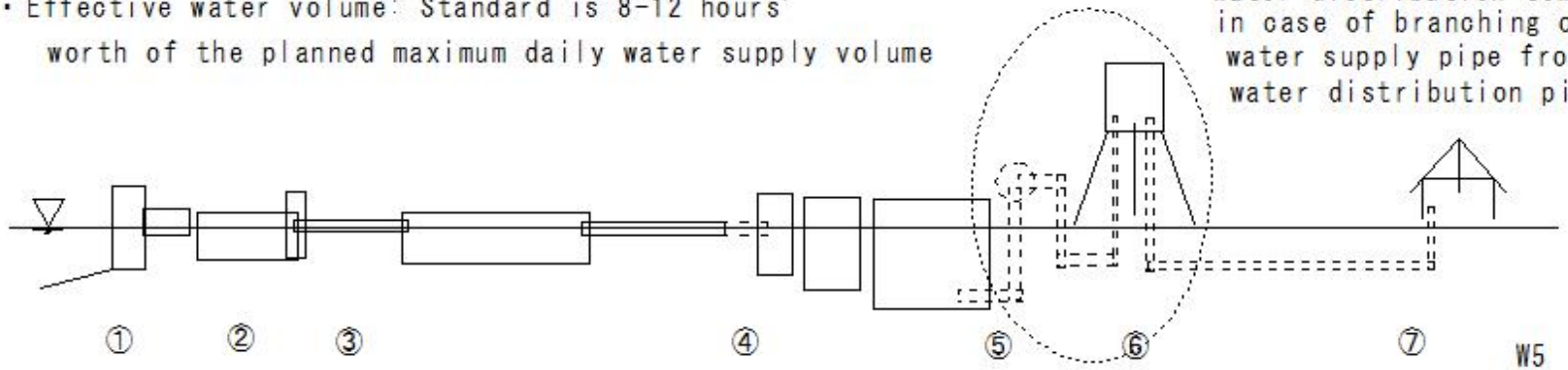
Water purification plant

Structure of the water supply

W1

⑥ Water distribution

Water distribution tower in case of branching off water supply pipe from water distribution pipe



W5

(W44)Water supply facilities(Water distribution facilities)

(W44)Water supply facilities(Water distribution facilities)

Water supply facilities

Location, arrangement, and structure of water purification facilities

Water distribution facilities

④ Water distribution pipes

・Water distribution reservoir → User

Pipe network

・Pipe type

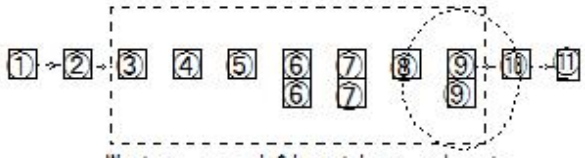
・Pipe diameter

・1.5kgf/cm2 or more

・Water pressure is evenly distributed within the water supply area

⑨ Distribution ponds

⑩ Distribution pipes

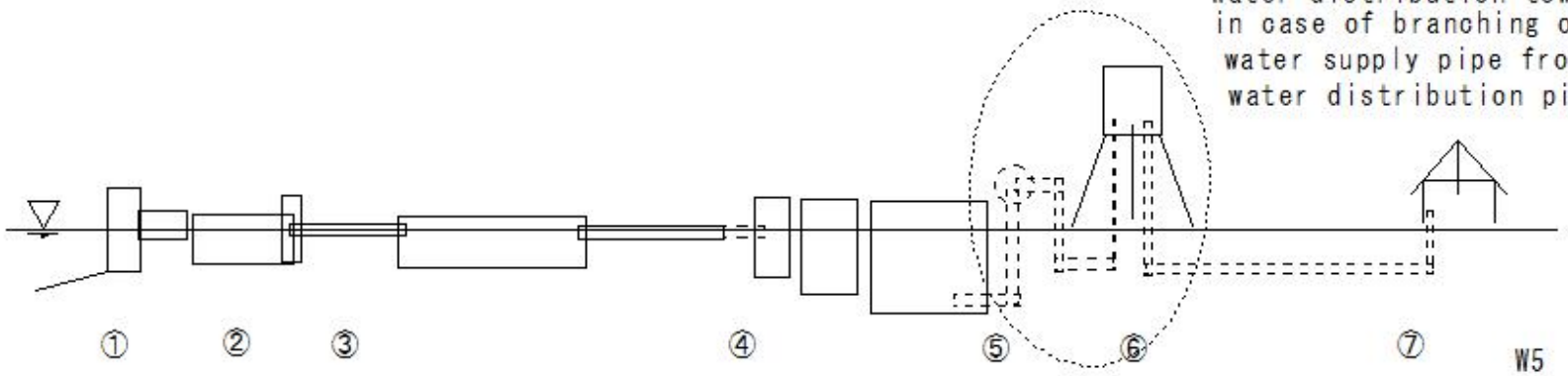


Structure of the water supply

W1

⑥ Water distribution

Water distribution tower in case of branching off water supply pipe from water distribution pipe



W5

(W45)Water supply facilities(Water distribution facilities)

(W45)Water supply facilities(Water distribution facilities)

Water supply facilities

Location and arrangement of water purification facilities

Water distribution facilities

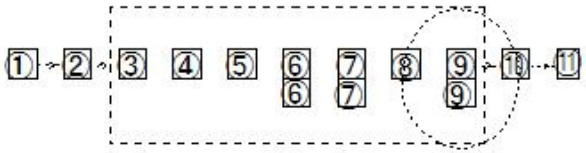
④ Water distribution pipes

Layout

・Supply pipes to main water supply pipes → Water distribution branch pipes

・Water distribution pipes → Avoid dead-end pipes - Mesh layout

⑨ Distribution ponds
⑩ Distribution pipes

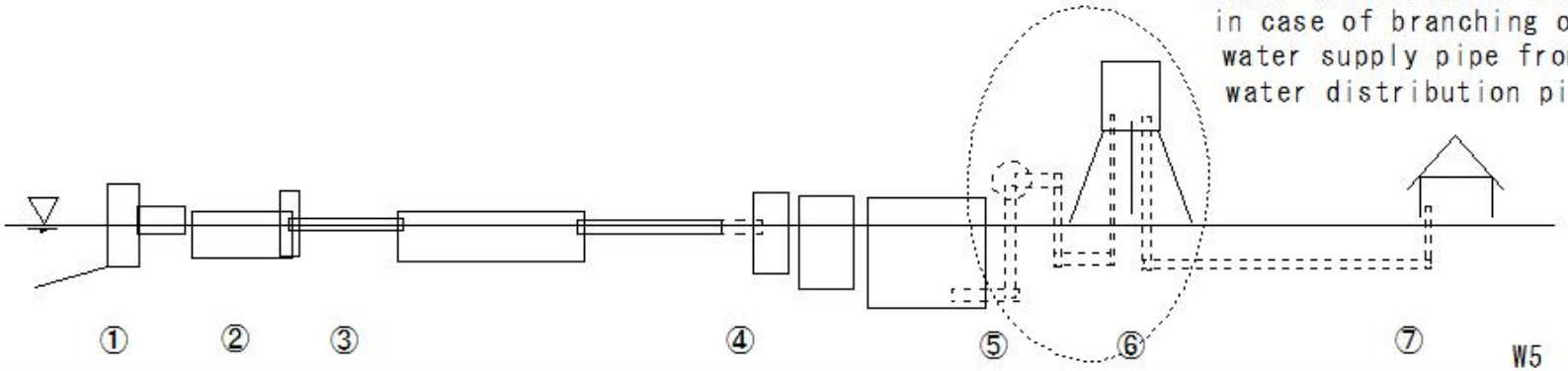


Structure of the water supply

W1

⑥ Water distribution

Water distribution tower in case of branching off water supply pipe from water distribution pipe



W5

(W46)Water supply facilities(Water distribution facilities)

(W46)Water supply facilities(Water distribution facilities)

Water supply facilities

Location and arrangement of water purification facilities

Water distribution facilities

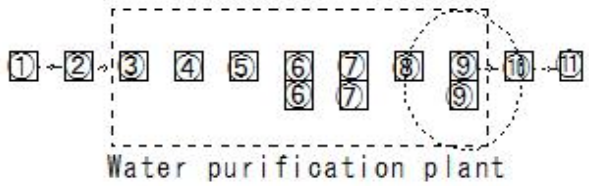
④Water distribution pipes

Fire hydrants → Road intersections and forks

100-200m intervals

⑨ Distribution ponds

⑩ Distribution pipes



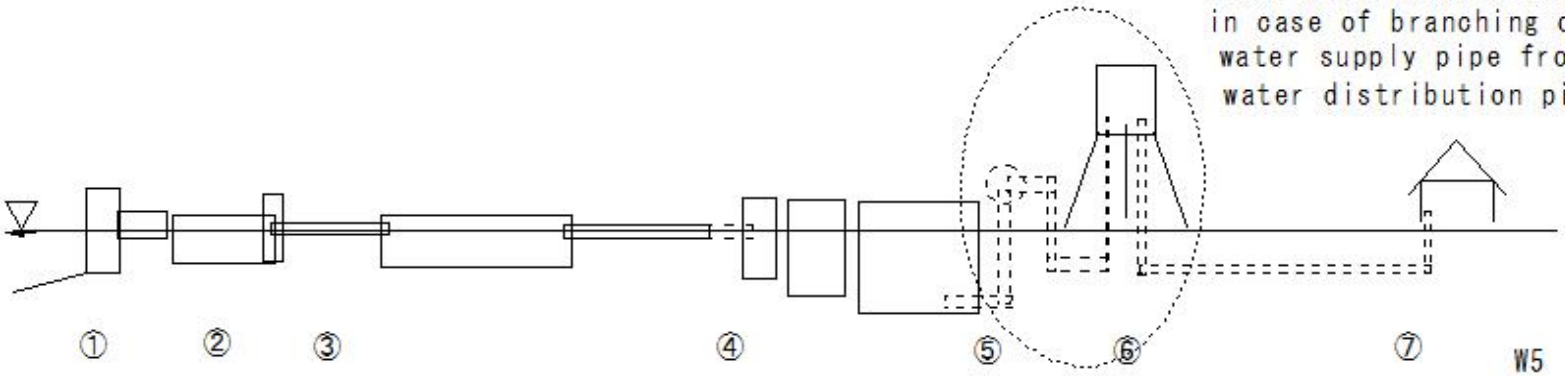
Water purification plant

Structure of the water supply

W1

⑥ Water distribution

Water distribution tower in case of branching off water supply pipe from water distribution pipe



W5

(W47)Water supply facilities(Water distribution facilities）

(W47)Water supply facilities(Water distribution facilities)

Water supply facilities

Position, arrangement, and structure of water purification facilities

Water distribution facilities

④Water distribution pipes

Pipe burial position and depth

・Water distribution main pipe → Close to the center of the road

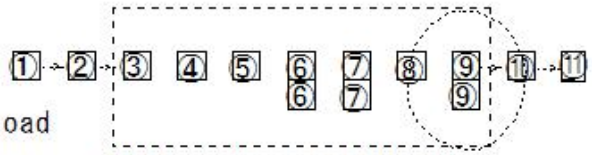
Water distribution branch pipe → Sidewalk, one side of the roadway

・in case of the road is wide, water distribution branch pipe → Sidewalks on both sides, both sides of the roadway

・Laying on the sidewalk → Burying depth of water distribution branch pipe → About 90 cm standard

・Water distribution pipe → Other underground buried objects in case of close to each other → At least 30 cm apart

⑨ Distribution ponds
⑩ Distribution pipes

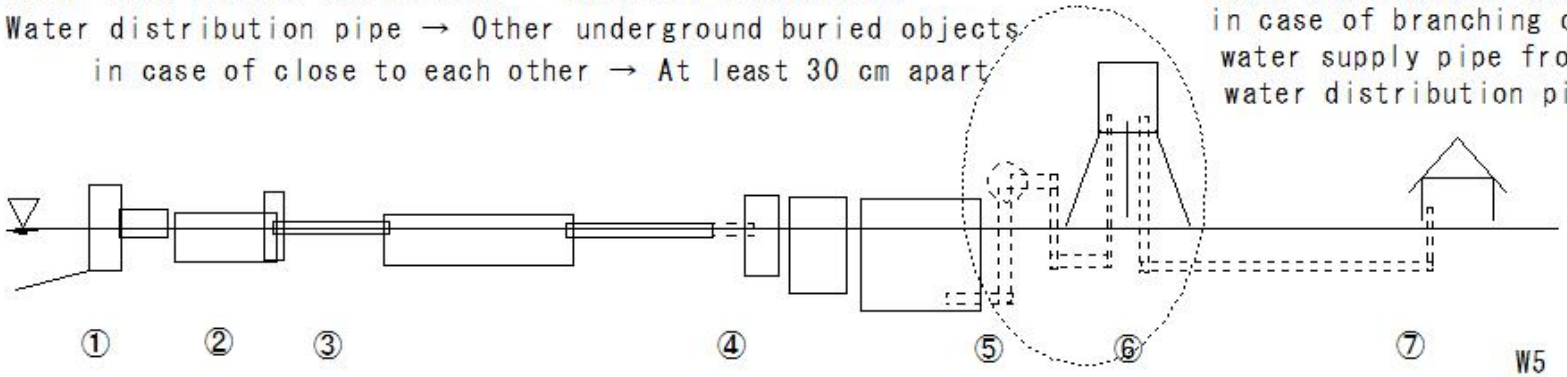


Structure of the water supply

W1

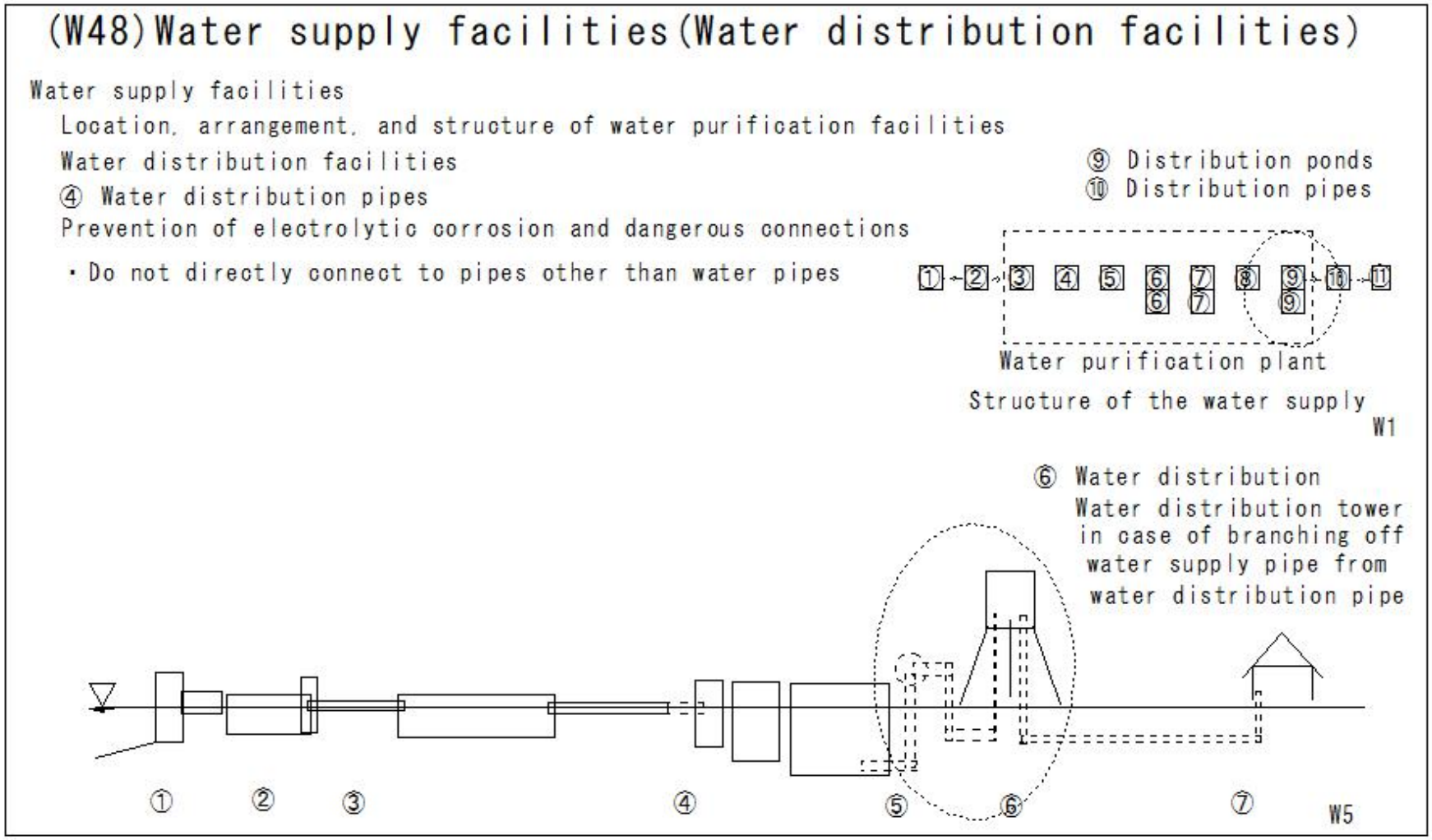
⑥ Water distribution

Water distribution tower in case of branching off water supply pipe from water distribution pipe

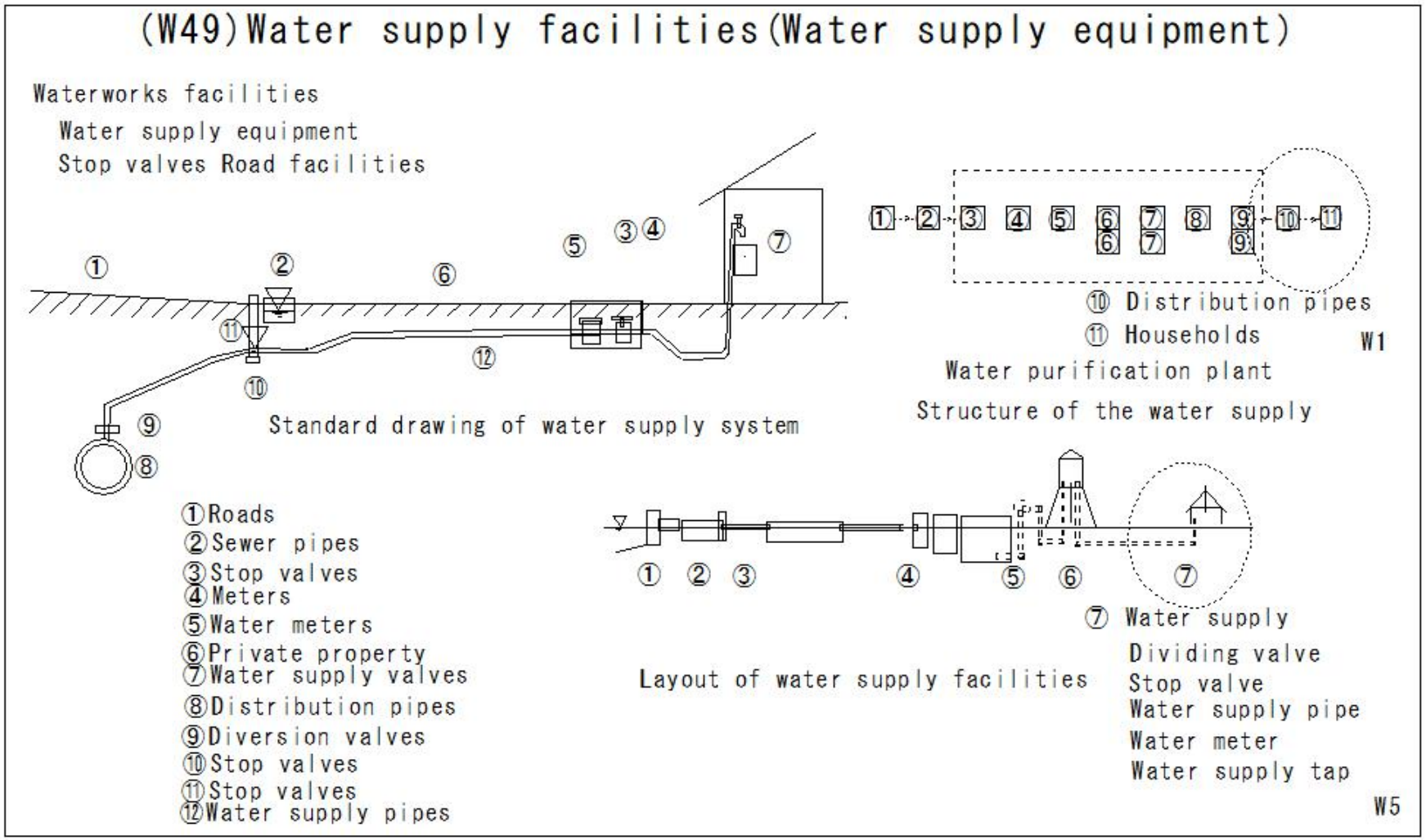


W5

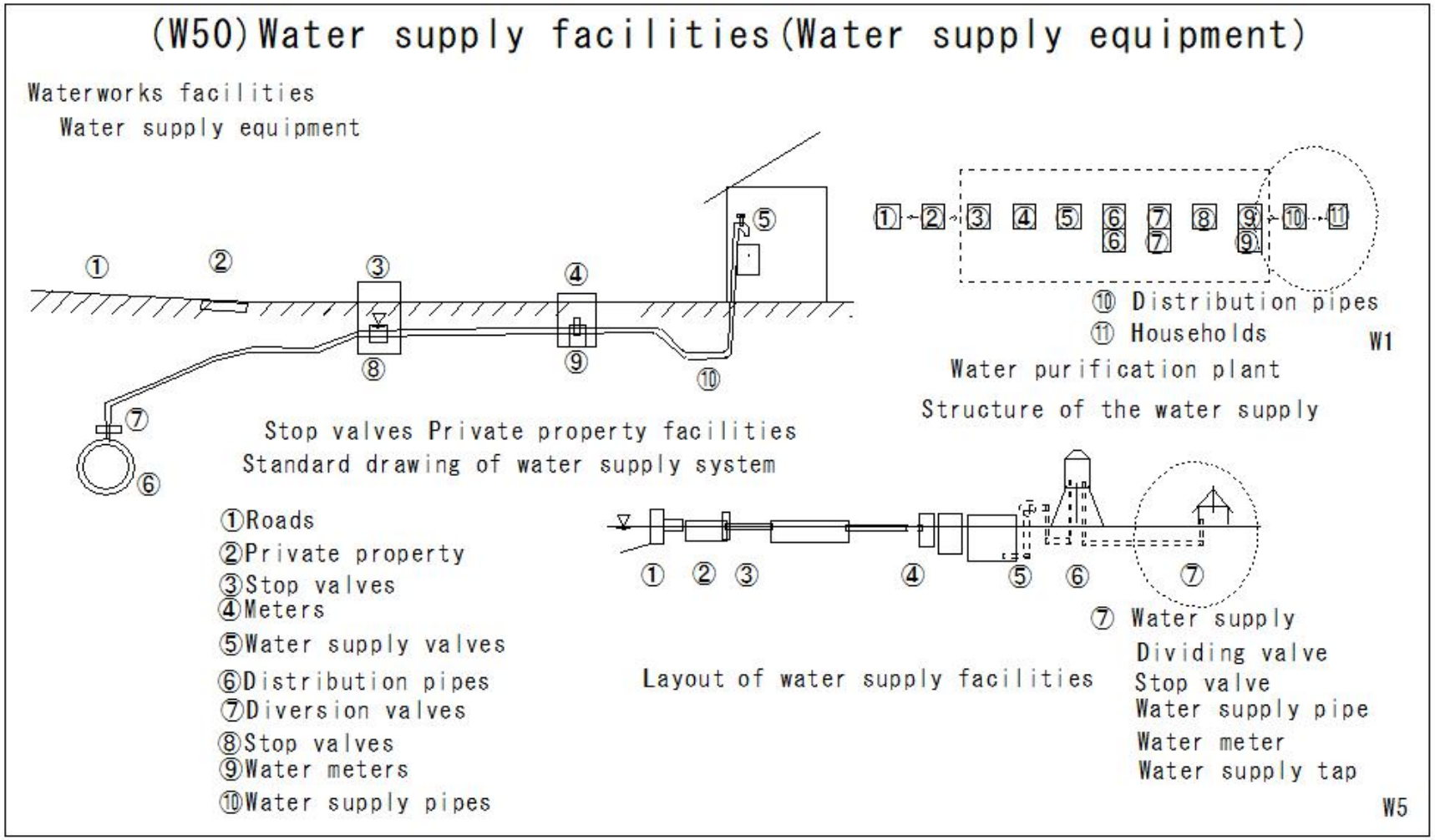
(W48)Water supply facilities(Water distribution facilities)



(W49)Water supply facilities(Water supply equipment)



(W50)Water supply facilities(Water supply equipment)



(W51)Water supply facilities(Water supply equipment)

(W51)Water supply facilities(Water supply equipment)

Waterworks facilities

Water supply equipment

①Water supply method: direct supply and tank type

②Designed water volume

③Pipe diameter

④Pipe

・Laying on public roads → Occupied location

・Water tap installation location → Convenient location

・Pipe line → Direct piping

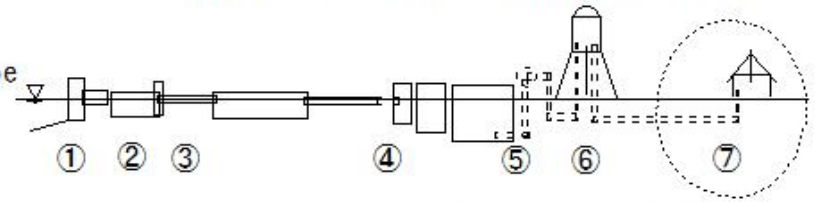
Keep away from sewage and wastewater

Avoid cross piping under building foundations and floors

・Water supply pipe → Basement, 2nd floor and above

→ Each floor - Water stop device

Layout of water supply facilities



⑦ Water supply

Dividing valve

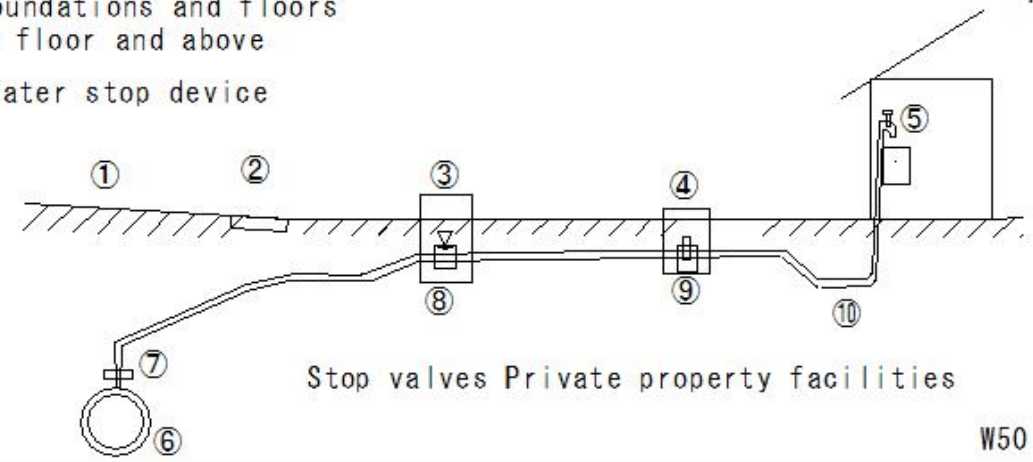
Stop valve

Water supply pipe

Water meter

Water supply tap

W5



Stop valves Private property facilities

W50

(W52)Water supply facilities(Water supply equipment)

(W52)Water supply facilities(Water supply equipment)

Waterworks facilities

Water supply equipment

⑤Dangerous connections

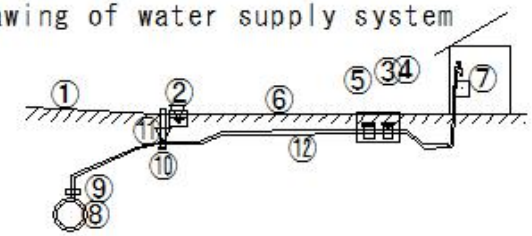
・Water supply pipe → Do not directly connect to pipes other than water pipes

・Water supply pipe outlet → Drop-in

Higher than the full water level

・Toilet flush valve → Do not directly connect to water supply pipe

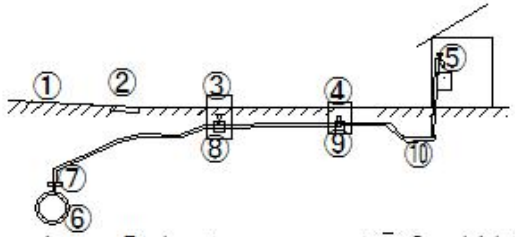
Standard drawing of water supply system



W49

Stop valves Road facilities

①Roads
②Sewer pipes
③Stop valves
④Meters
⑤Water meters
⑥Private property
⑦Water supply valves
⑧Distribution pipes
⑨Diversion valves
⑩Stop valves
⑪Stop valves
⑫Water supply pipes



W50

Stop valves Private property facilities

①Roads
②Private property
③Stop valves
④Meters
⑤Water supply valves
⑥Distribution pipes
⑦Diversion valves
⑧Stop valves
⑨Water meters
⑩Water supply pipes

(W53)Water supply facilities(Water supply equipment)

(W53)Water supply facilities(Water supply equipment)

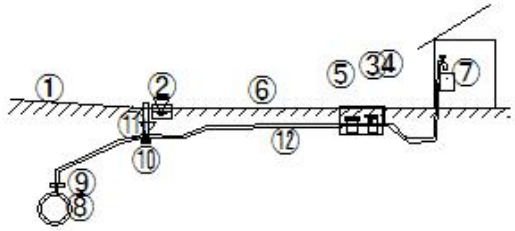
Waterworks facilities

Water supply equipment

⑥Types of water supply pipes

- Ductile iron pipes
- Steel pipes
- Stainless steel pipes
- Copper pipes
- Rigid polyvinyl chloride pipes
- Polyethylene pipes

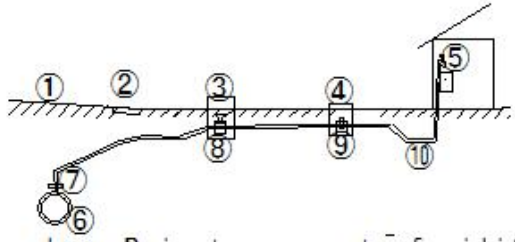
Standard drawing of water supply system



W49

Stop valves Road facilities

①Roads
②Sewer pipes
③Stop valves
④Meters
⑤Water meters
⑥Private property
⑦Water supply valves
⑧Distribution pipes
⑨Diversion valves
⑩Stop valves
⑪Stop valves
⑫Water supply pipes



W50

Stop valves Private property facilities

①Roads
②Private property
③Stop valves
④Meters
⑤Water supply valves
⑥Distribution pipes
⑦Diversion valves
⑧Stop valves
⑨Water meters
⑩Water supply pipes

(W54)Water supply facilities(Water supply equipment)

(W54)Water supply facilities(Water supply equipment)

Waterworks facilities

Water supply equipment

⑦Other equipment

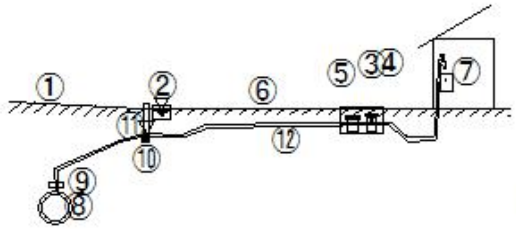
・Water meter

・Water inlet

・Water heater

・Water cooler

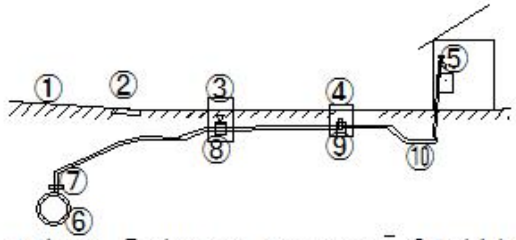
Standard drawing of water supply system



W49

Stop valves Road facilities

①Roads
②Sewer pipes
③Stop valves
④Meters
⑤Water meters
⑥Private property
⑦Water supply valves
⑧Distribution pipes
⑨Diversion valves
⑩Stop valves
⑪Stop valves
⑫Water supply pipes



W50

Stop valves Private property facilities

①Roads
②Private property
③Stop valves
④Meters
⑤Water supply valves
⑥Distribution pipes
⑦Diversion valves
⑧Stop valves
⑨Water meters
⑩Water supply pipes

(W55)Water supply facilities(Water supply equipment)

(W55)Water supply facilities(Water supply equipment)

Waterworks facilities

Water supply equipment

⑧Laying water supply pipes

①Depth of buried water supply pipes

Regulations for underground buried objects

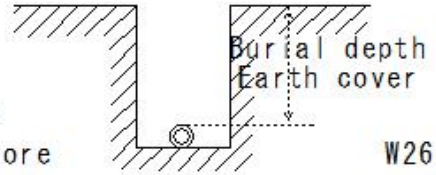
・On public roads

Roadways: 120cm or more

Sidewalks: 90cm or more

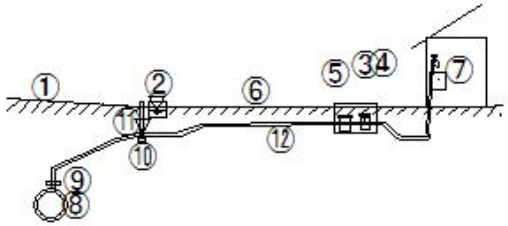
On private roads: 60cm or more

On private property: 30cm or more



W26

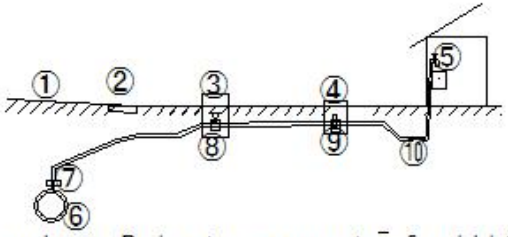
Standard drawing of water supply system



Stop valves Road facilities

①Roads
②Sewer pipes
③Stop valves
④Meters
⑤Water meters
⑥Private property
⑦Water supply valves
⑧Distribution pipes
⑨Diversion valves
⑩Stop valves
⑪Stop valves
⑫Water supply pipes

W49

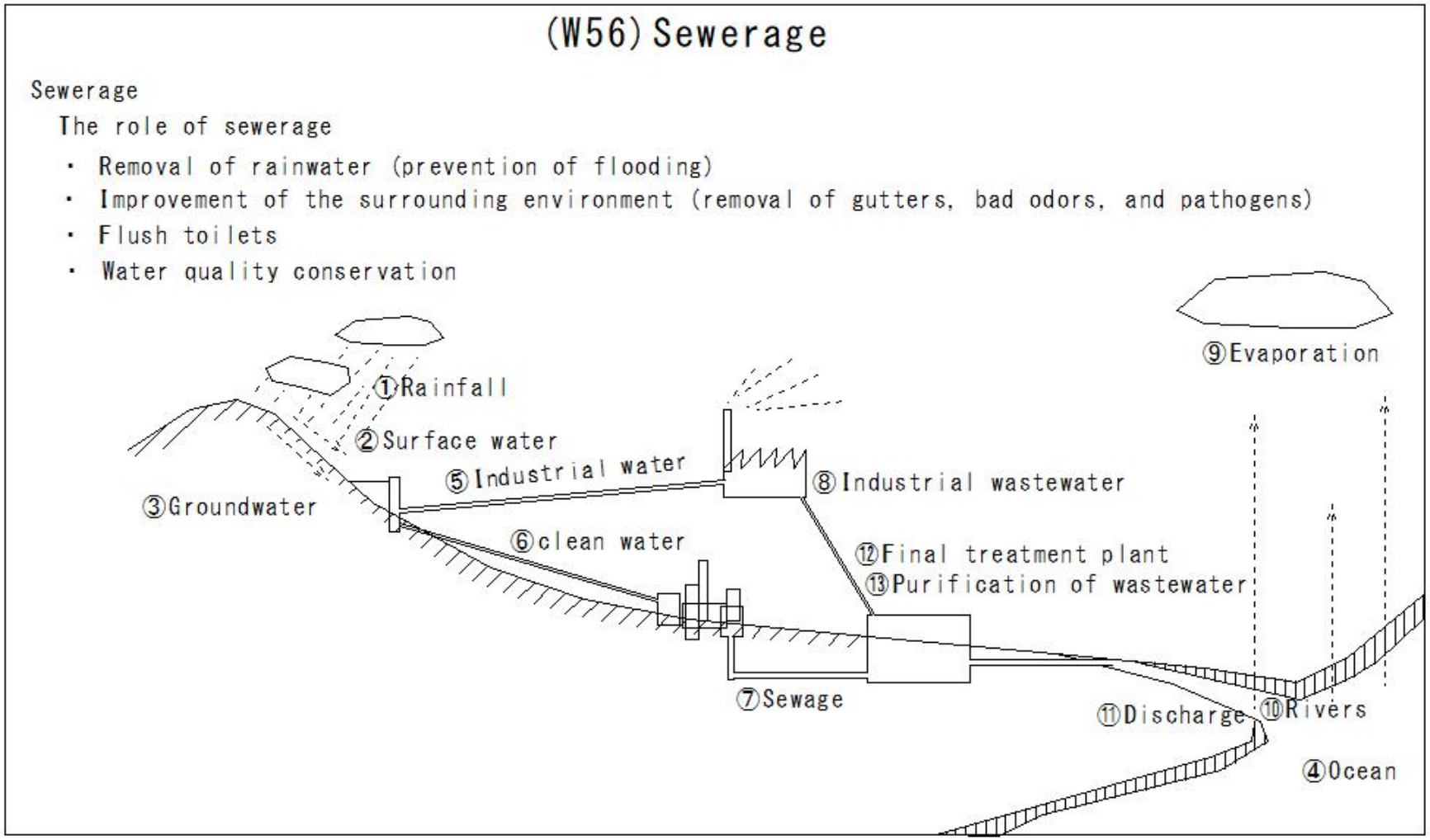


Stop valves Private property facilities

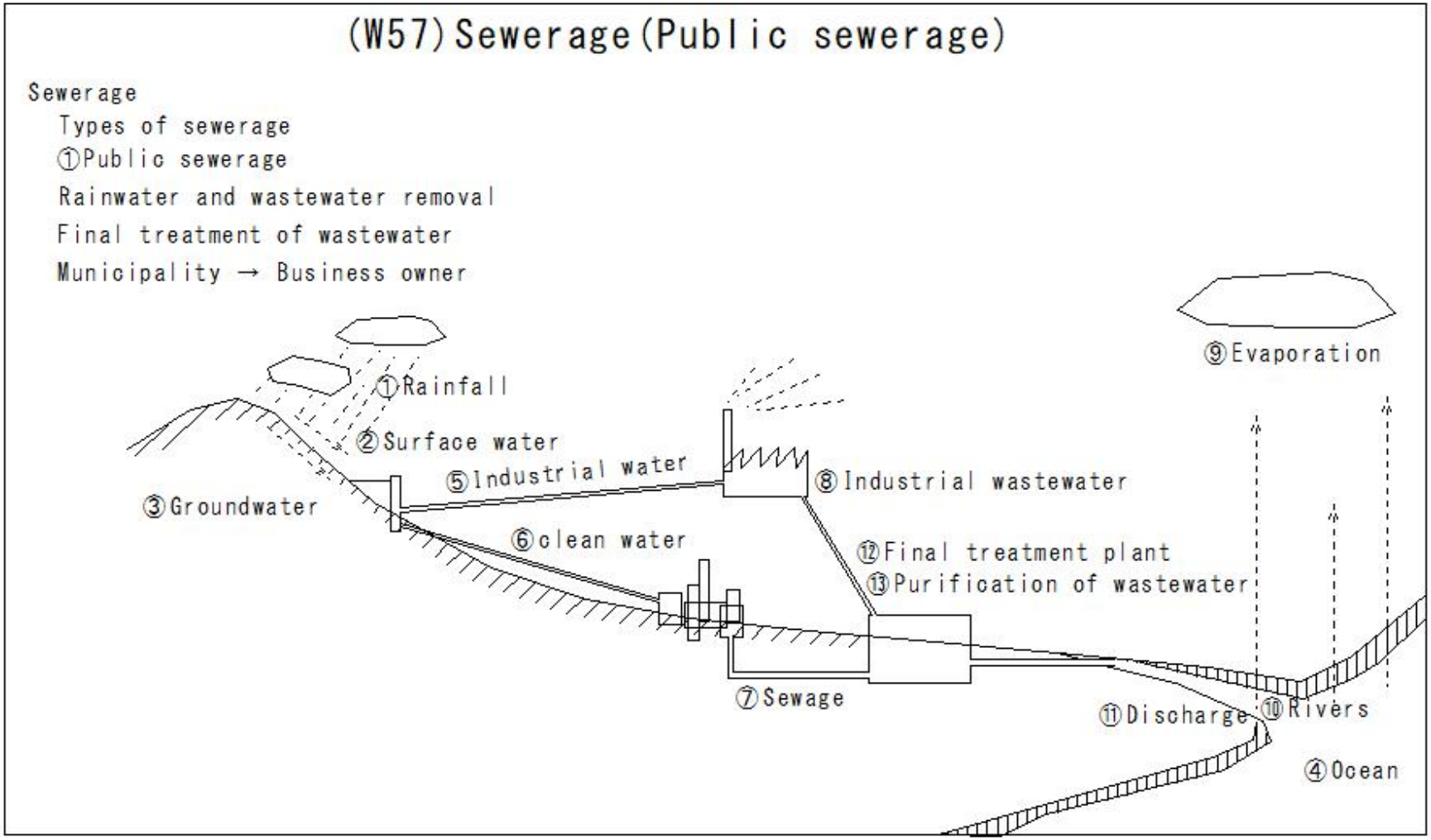
①Roads
②Private property
③Stop valves
④Meters
⑤Water supply valves
⑥Distribution pipes
⑦Diversion valves
⑧Stop valves
⑨Water meters
⑩Water supply pipes

W50

(W56)Sewerage



(W57)Sewerage(Public sewerage)



(W58)Sewerage(River basin sewerage)

(W58)Sewerage(River basin sewerage)

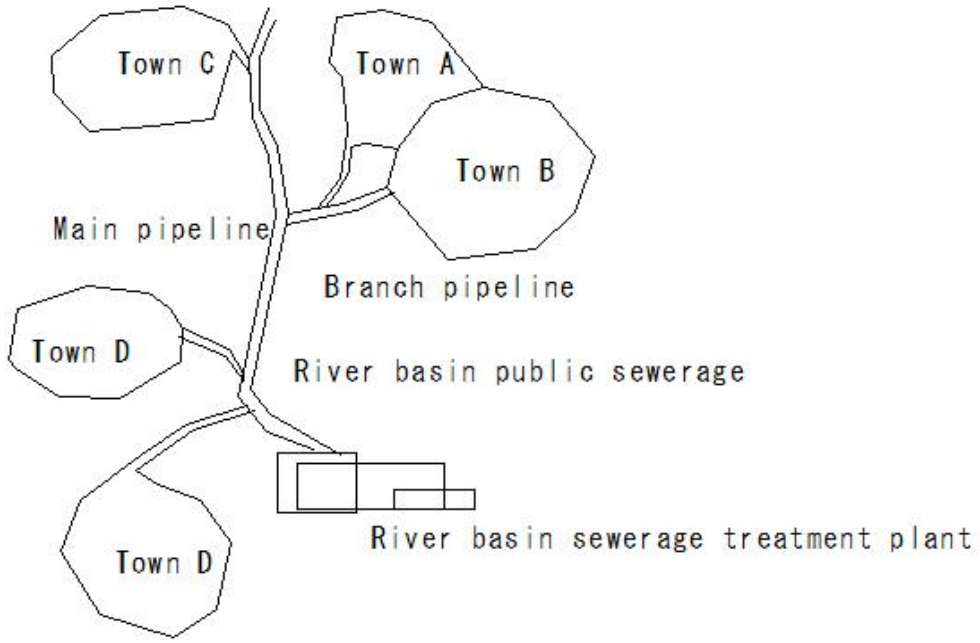
Sewerage

Types of sewerage

②River basin sewerage

Rivers, lakes and marshes → Prevention of water pollution

Managed by prefectures



(W59)Sewerage(Urban sewerage)

(W59)Sewerage(Urban sewerage)

Sewerage

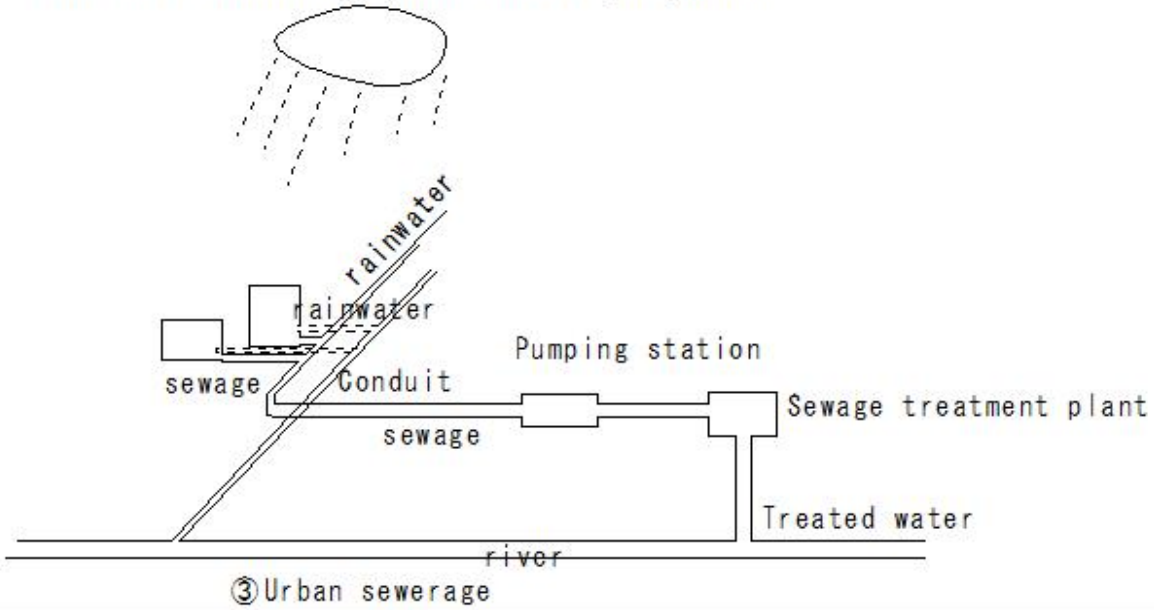
Types of sewerage

③Urban sewerage

Catchment area 2km2 or more → Urban river

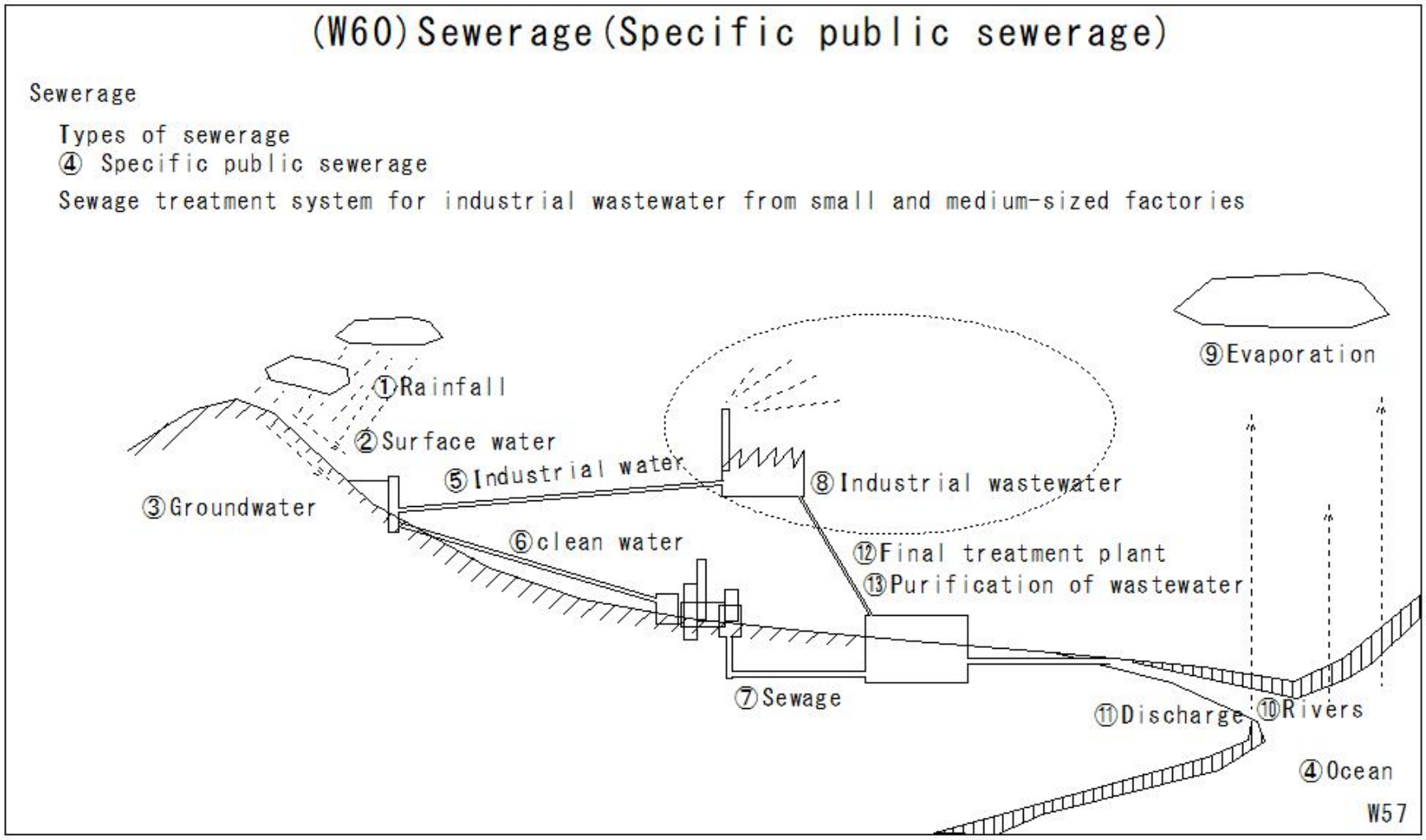
Catchment area 2km2 or less → Urban sewerage

Facilities that remove rainwater from urban areas and quickly drain it into rivers, etc. in municipalities that do not have public sewerage systems.

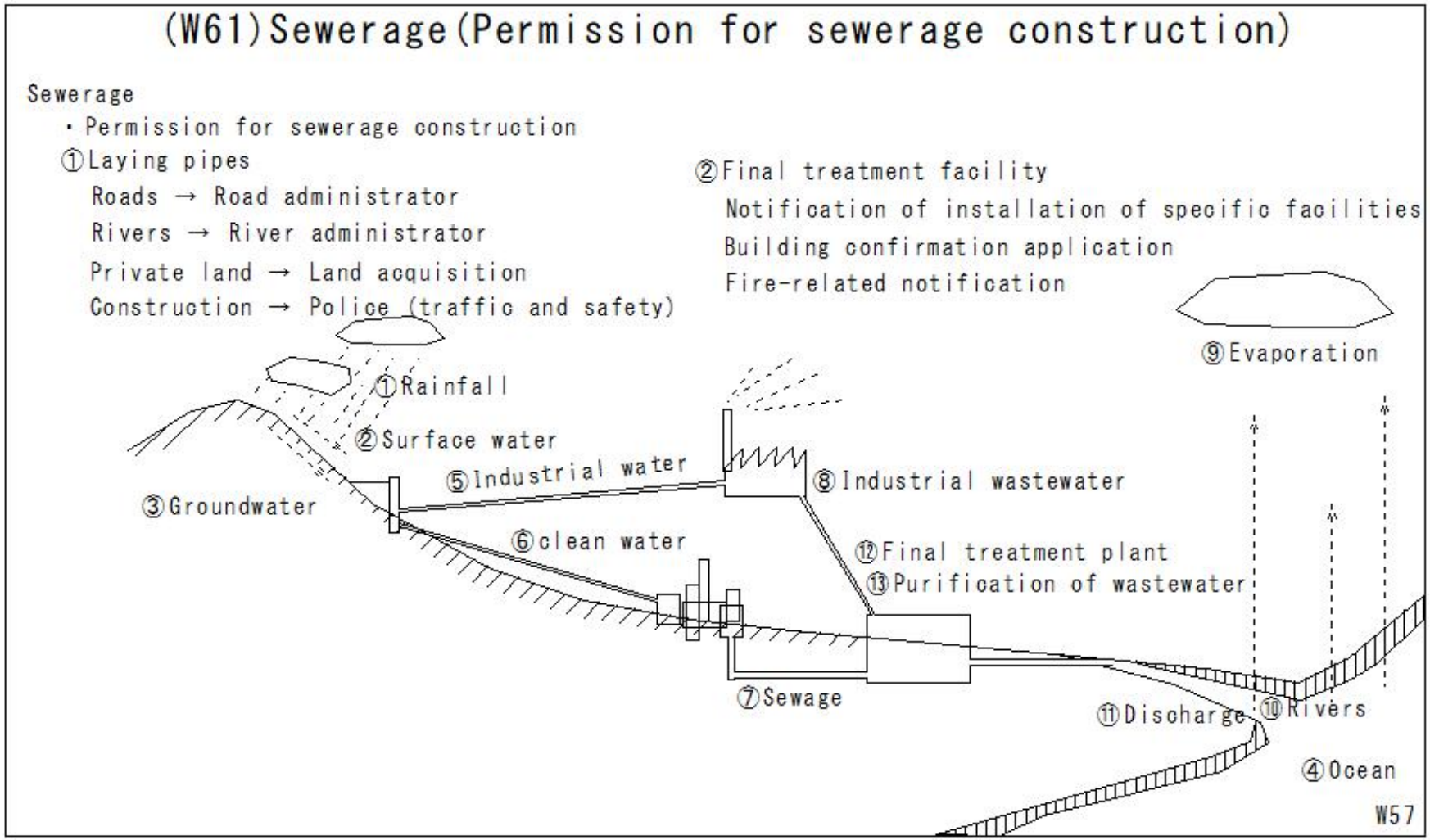


③Urban sewerage

(W60)Sewerage(Specific public sewerage)



(W61)Sewerage(Permission for sewerage construction)



(W62)Sewerage(Components)

(W62)Sewerage(Components)

・Sewerage planning

①Components of sewerage

Drainage facilities

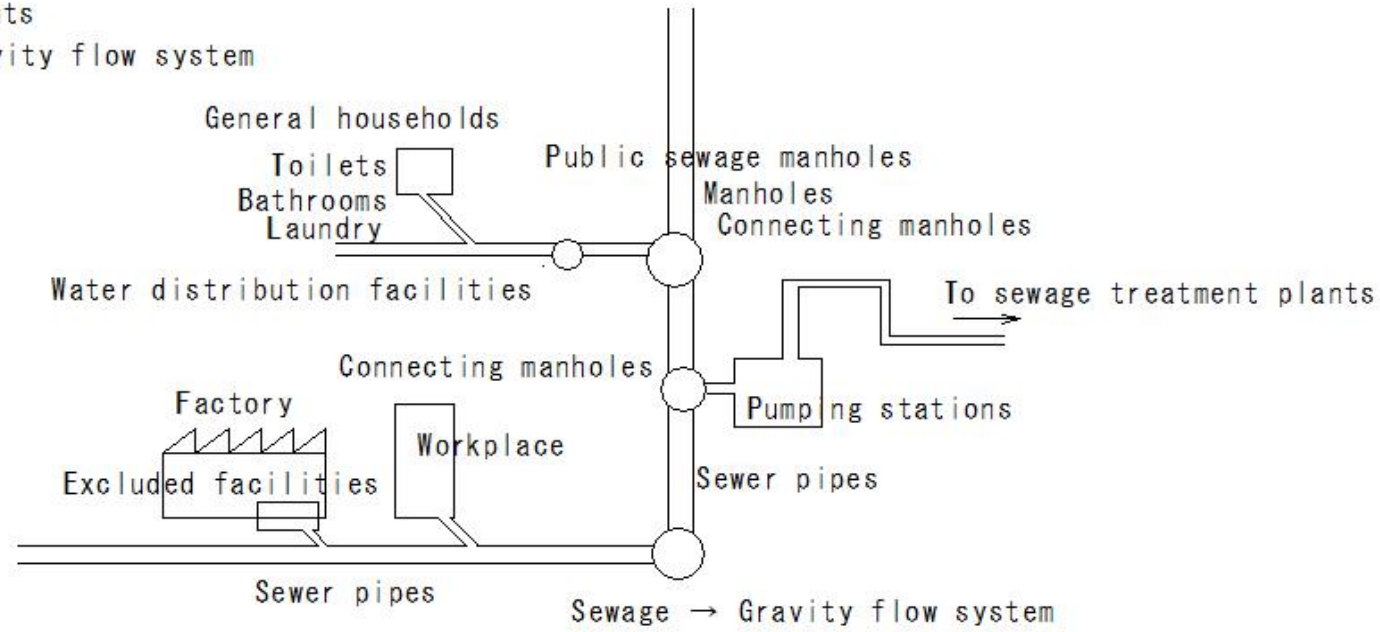
Branch pipes

Main pipes

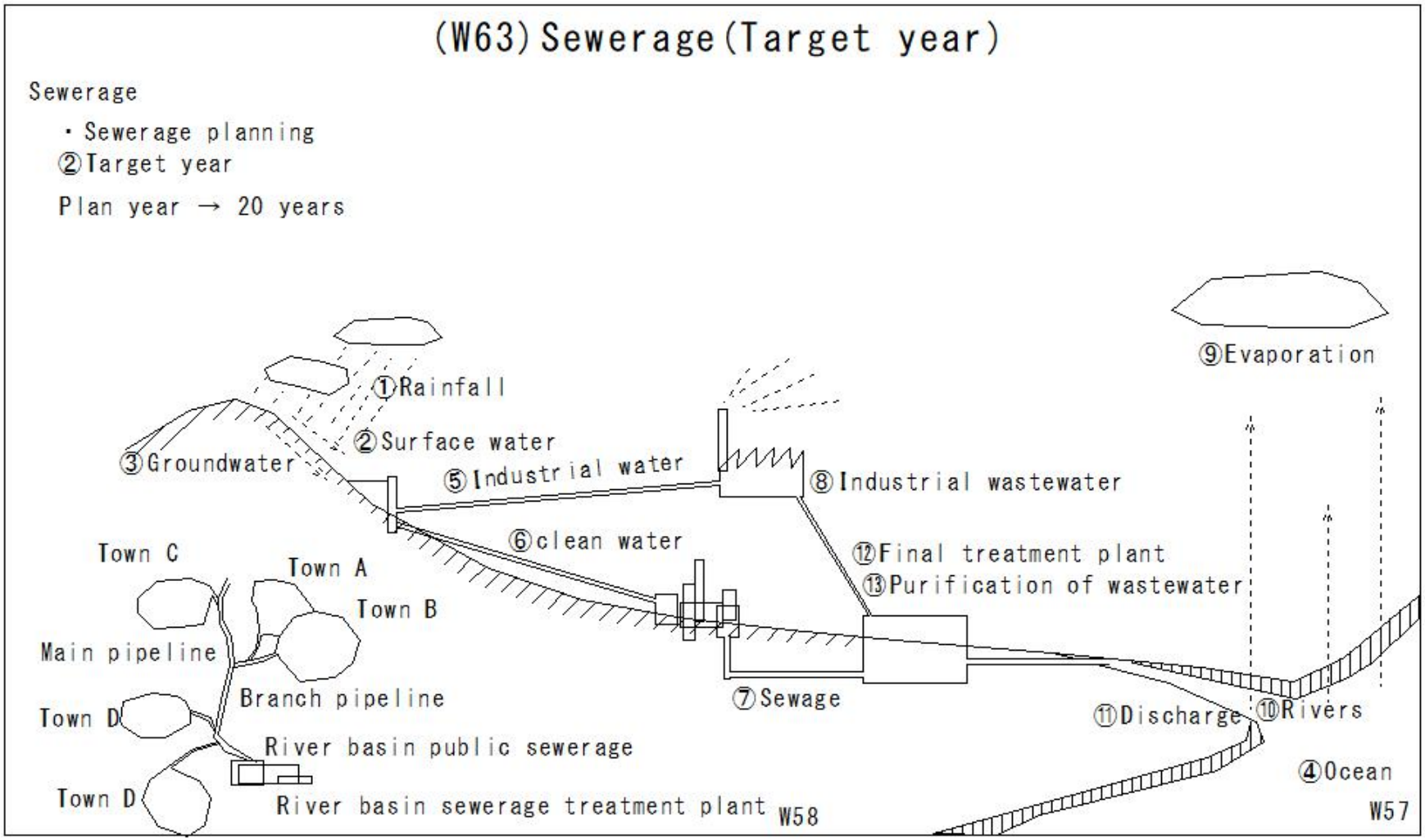
Pumping stations

Treatment plants

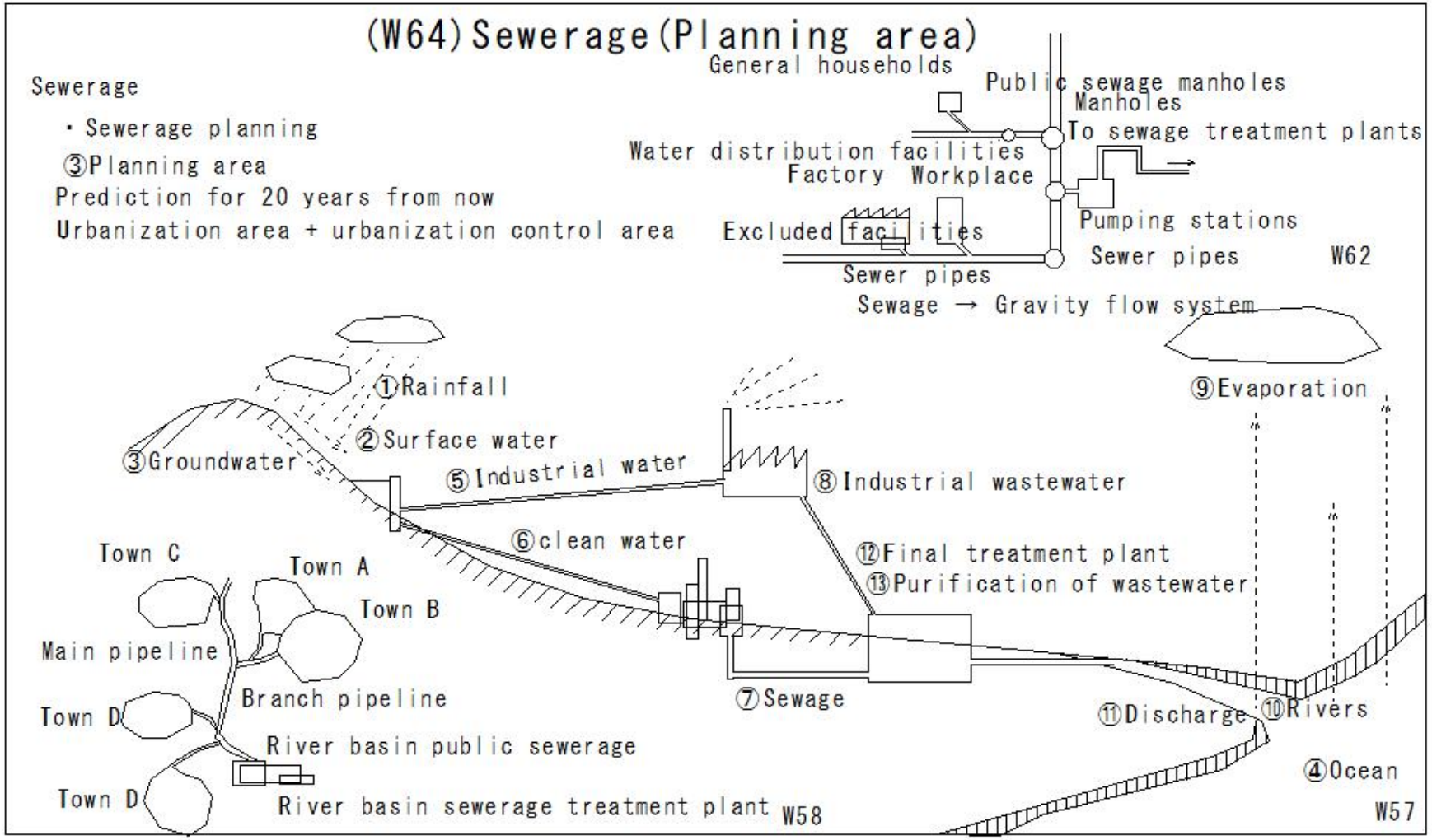
Sewage → Gravity flow system



(W63)Sewerage(Target year)



(W64)Sewerage(Planning area)



(W65)Sewerage(Planned sewage volume and water quality)

(W65)Sewerage(Planned sewage volume and water quality)

Sewerage

・Sewerage planning

④ Planned sewage volume and water quality

① Determining rainwater

・Rainfall intensity formula

$I=a/(t+b)$

a, b: Constants determined from rainfall records

t: Duration of rainfall

② Flow velocity in sewer pipes

0.6m/s≦sewage pipe≦3.0m/s

0.8m/s≦rain water pipe≦3.0m/s

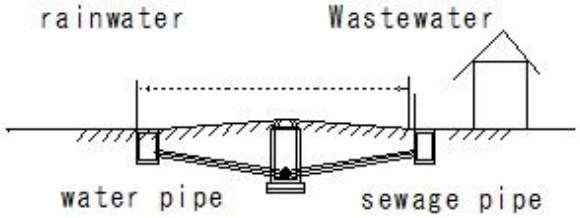
in case of it is slow, waste will settle

in case of it is fast, materials such as concrete pipes will be damaged

separate system

W261

combined system



W236

○: Large circle: water pipe
◦: Small circle: sewage pipe

(W66)Sewerage(Combined type/ Separate type)

(W66)Sewerage(Combined type/ Separate type)

Sewerage

Sewerage planning

⑤ Wastewater removal method

① Combined type

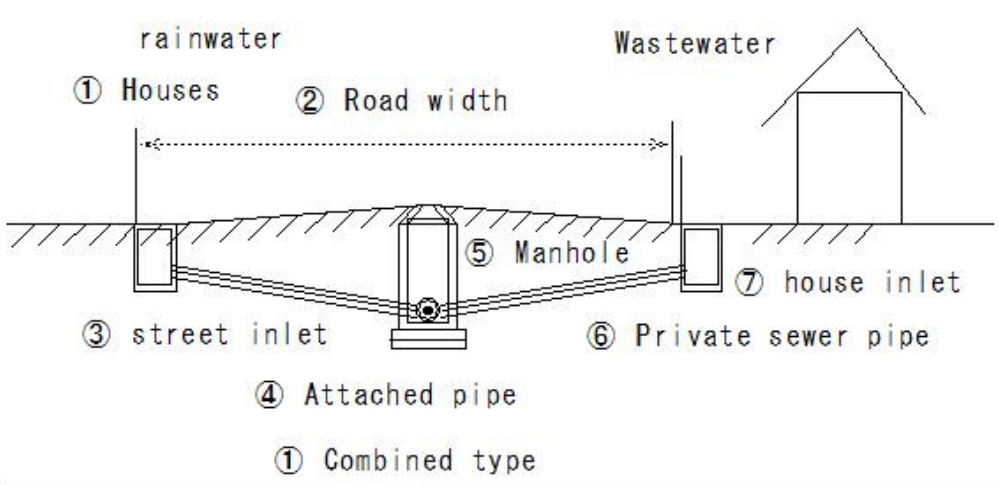
Wastewater and rainwater are discharged through the same pipe

in case of there is a lot of rainfall → Discharged without treatment

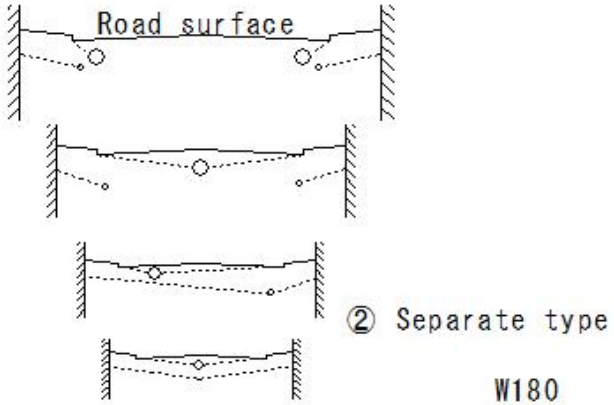
② Separate type

Wastewater and rainwater are discharged through separate pipes

Wastewater is treated and then discharged → Water quality is maintained Cost → High



① Combined type



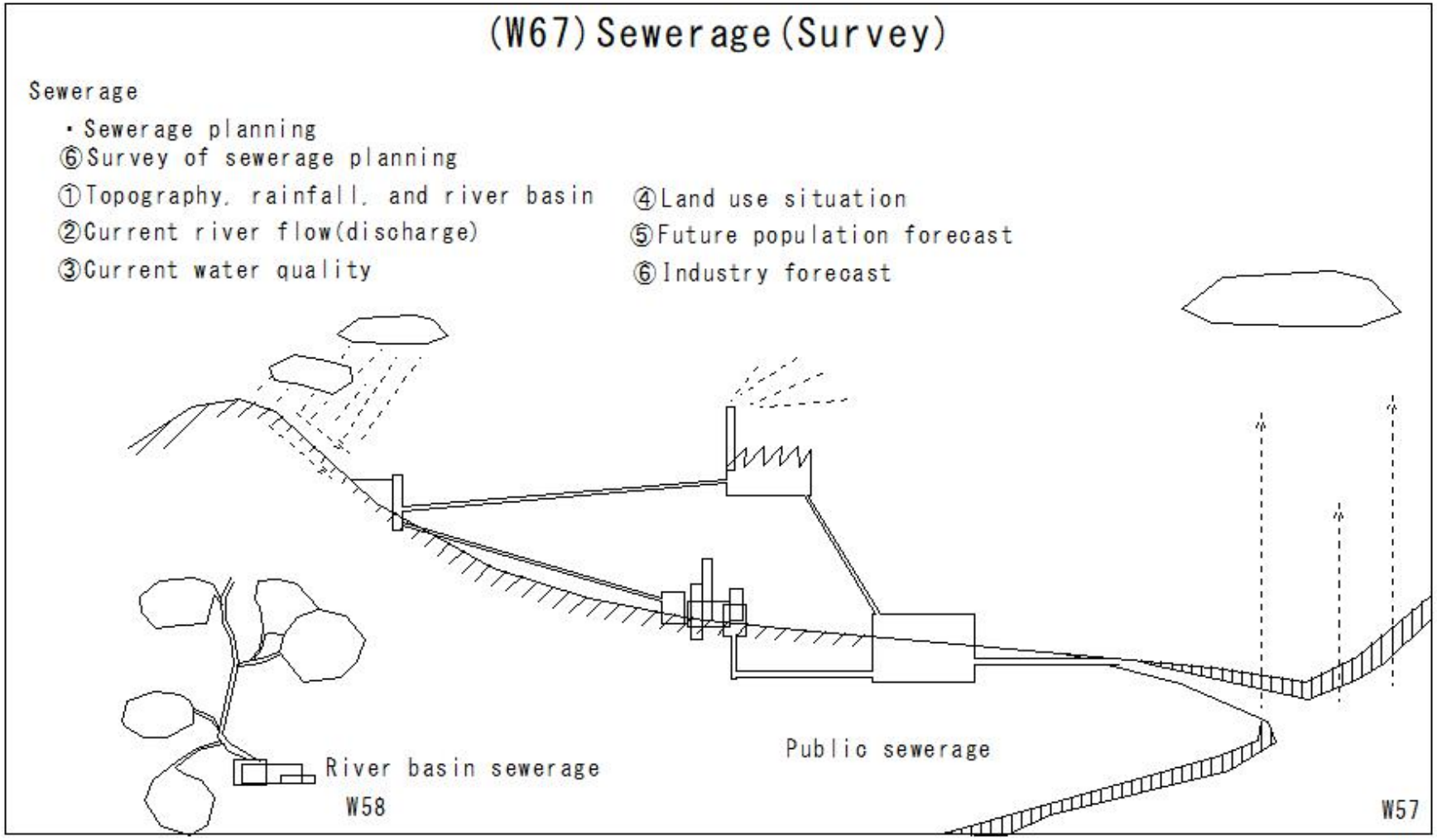
② Separate type

W180

○: Large circle: water pipe

◦: Small circle: sewage pipe

(W67)Sewerage(Survey)

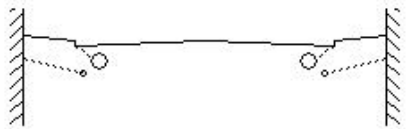
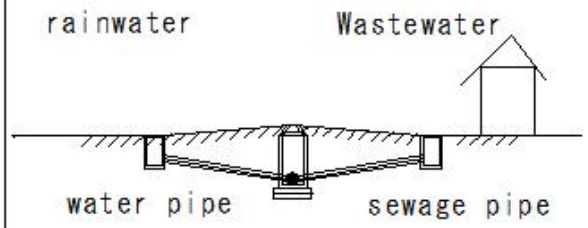


(W68)Sewerage(Comparison of sewage methods)

(W68)Sewerage(Comparison of sewage methods)

Sewerage

Comparison of sewage methods

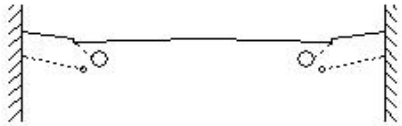
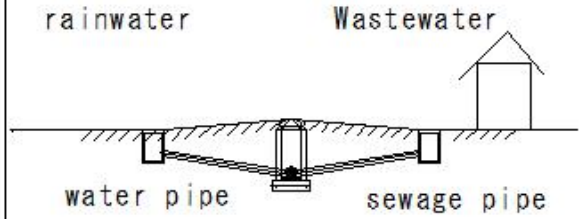
	separate system	combined system
	 W261 ○: Large circle: water pipe ◦: Small circle: sewage pipe	 W236
(1) Construction cost	It is cheaper in case of there is an existing drainage system.	Cheaper than new construction of a complete flow diversion type

(W69)Sewerage(Comparison of sewage methods)

(W69) Sewerage (Comparison of sewage methods)

Sewerage

Comparison of sewage methods

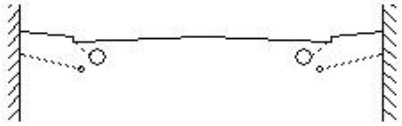
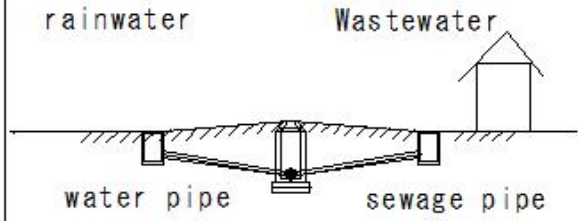
	separate system	combined system
	 W261 ○: Large circle: water pipe ◦: Small circle: sewage pipe	 W236
② Difficulty of construction	Two buried pipes - difficult	Easier than the separate type

(W70)Sewerage(Comparison of sewage methods)

(W70)Sewerage(Comparison of sewage methods)

Sewerage

Comparison of sewage methods

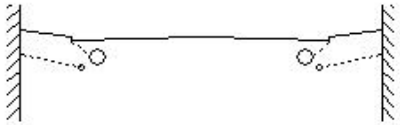
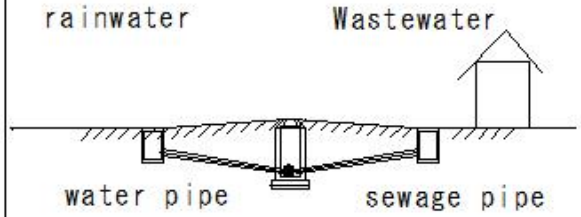
	separate system	combined system
	 W261 ○: Large circle: water pipe ◦: Small circle: sewage pipe	 W236
③ Buried depth of pipes	To obtain a high flow velocity, the gradient must be increased It becomes deeper A pump station in the middle is necessary	It can be shallower than the separate type

(W71)Sewerage(Comparison of sewage methods)

(W71)Sewerage(Comparison of sewage methods)

Sewerage

Comparison of sewage methods

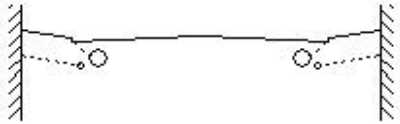
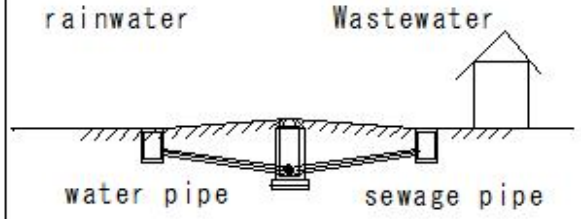
	separate system	combined system
	 W261 ○: Large circle: water pipe ◦: Small circle: sewage pipe	 W236
④ Final treatment plant	Small scale Little change in water quality and volume Treatment - stable	Large scale During rainfall - Large change in water quality and volume Treatment - unstable

(W72)Sewerage(Comparison of sewage methods)

(W72)Sewerage(Comparison of sewage methods)

Sewerage

Comparison of sewage methods

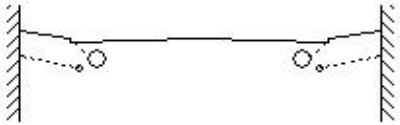
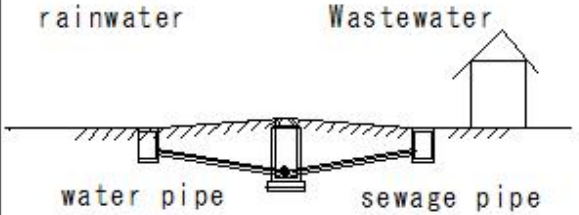
	separate system	combined system
	 W261 ○: Large circle: water pipe ◦: Small circle: sewage pipe	 W236
⑤ Cleaning inside the pipe	Upstream - Sediment formation Flushing - Required	Natural flushing during rainy weather

(W73)Sewerage(Comparison of sewage methods)

(W73)Sewerage(Comparison of sewage methods)

Sewerage

Comparison of sewage methods

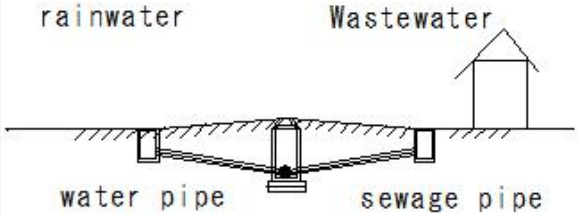
	separate system	combined system
	 W261 ○: Large circle: water pipe ◦: Small circle: sewage pipe	 W236
⑥ Sediment inflow	little	much

(W74)Sewerage(Comparison of sewage methods)

(W74)Sewerage(Comparison of sewage methods)

Sewerage

Comparison of sewage methods

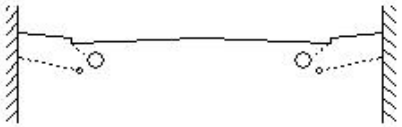
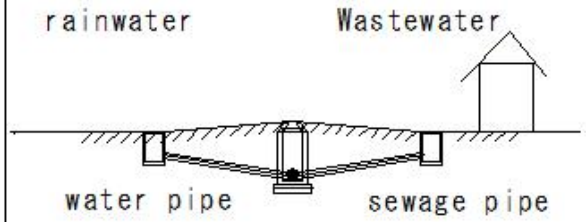
	separate system	combined system
	 W261 ○: Large circle: water pipe ◦: Small circle: sewage pipe	 W236
⑦Connecting drainage equipment	Complicated - prone to errors	Easy

(W75)Sewerage(Comparison of sewage methods)

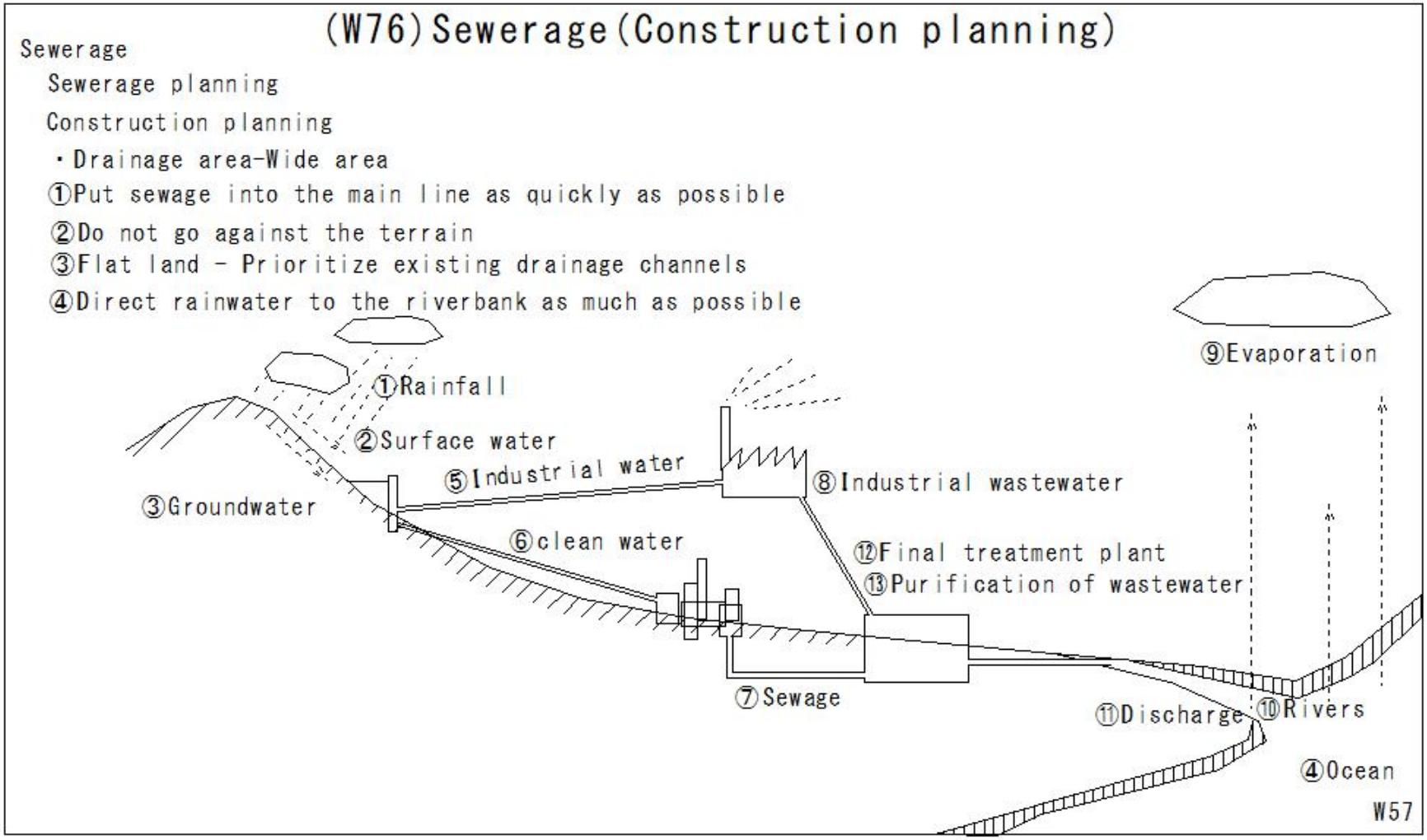
(W75) Sewerage (Comparison of sewage methods)

Sewerage

Comparison of sewage methods

	separate system	combined system
	 W261 ○: Large circle: water pipe ◦: Small circle: sewage pipe	 W236
⑧ Pollution at the discharge destination	Pollution caused by sewage disappears Initial stage: Pollutants caused by rainfall - runoff	As the amount of rainfall increases, sewage is diluted and runs off

(W76)Sewerage(Construction planning)



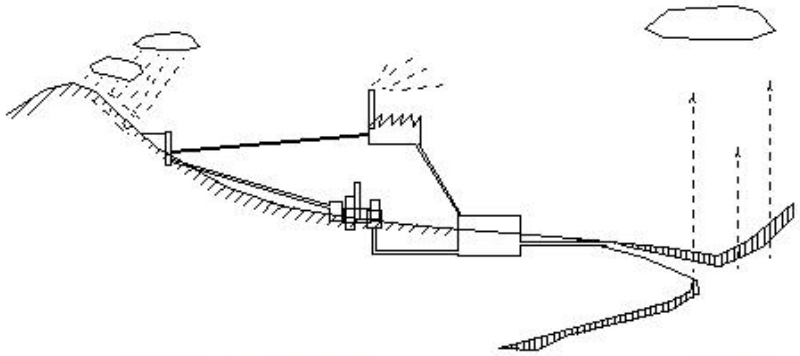
(W77)Sewerage(Pipe construction)

(W77) Sewerage (Pipe construction)

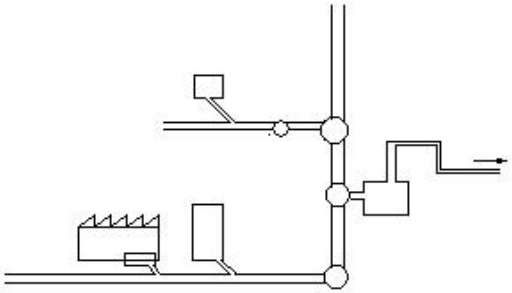
Sewerage

Sewerage planning
Construction plan
・Pipe construction
Sewage drainage system

① Right angle (vertical)
② Interceptor type: Most combined types
③ Fan-shaped type: Collects sewage in a fan shape to one point
④ Radial type: Requires multiple treatment plants
⑤ Parallel type: Areas with large elevation changes
⑥ Centralized type: Collects from all sides and drains into the main line

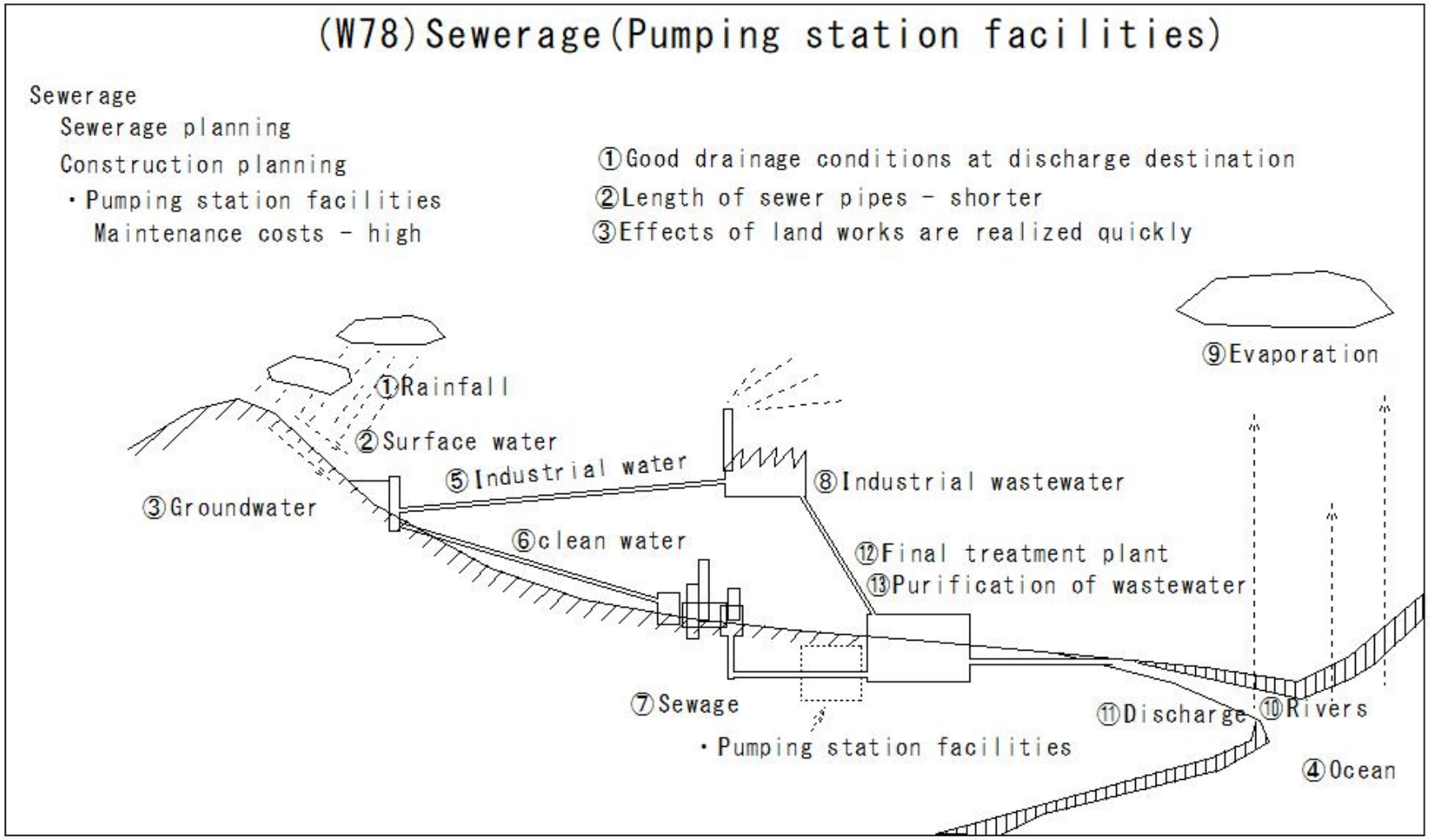


Public sewerage W57

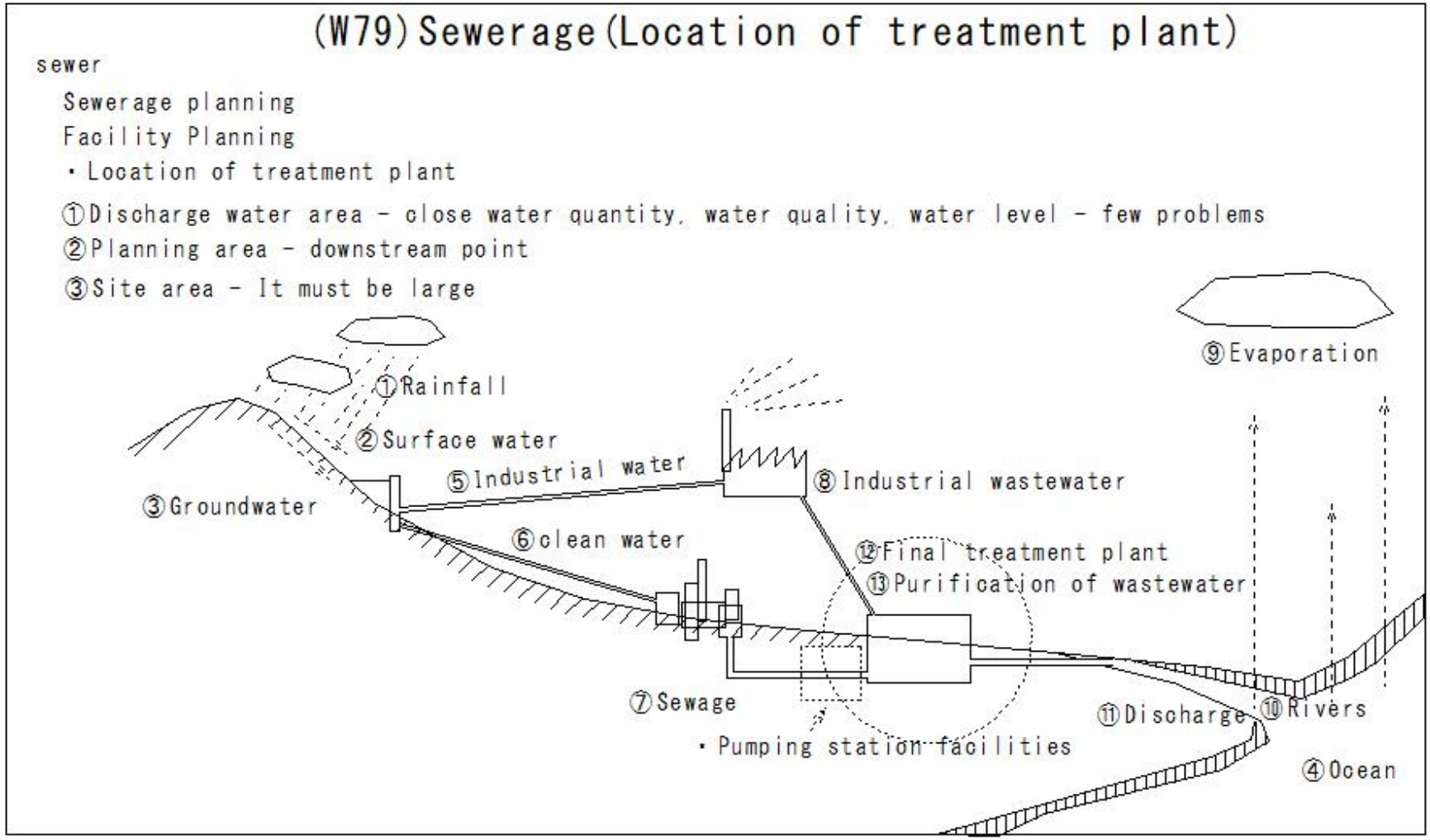


①Components of sewerage W62

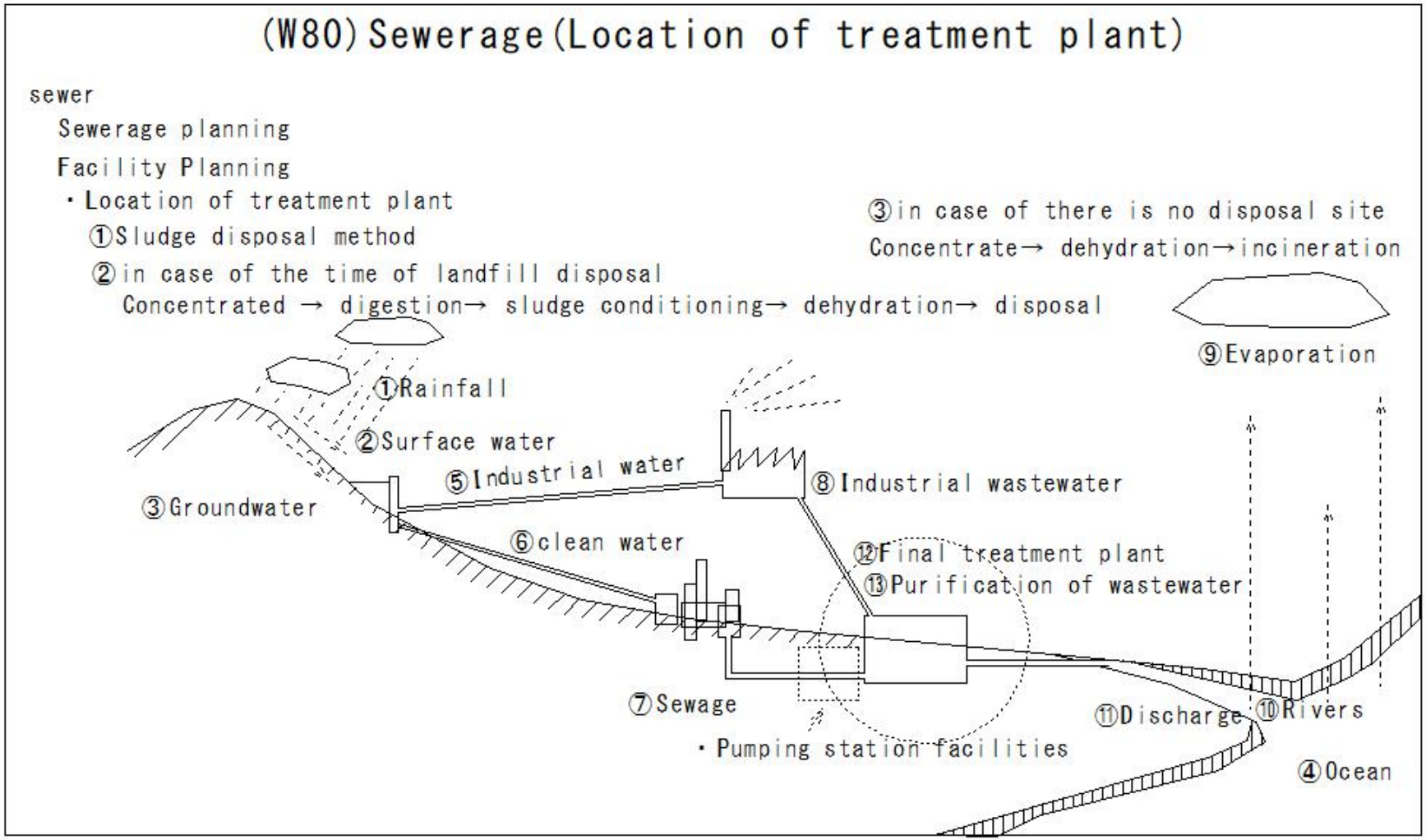
(W78)Sewerage(Pumping station facilities)



(W79)Sewerage(Location of treatment plant)



(W80)Sewerage(Location of treatment plant)



(W81)Sewerage(Classification by material)

(W81)Sewerage(Classification by material)

sewer

・Sewerage planning

Pipeline Facilities

・Type of pipe

①Classification by material

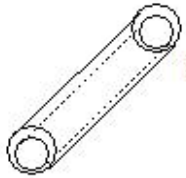
Factory Products

Ceramic pipes, reinforced concrete pipes, centrifugal reinforced concrete pipes, reinforced plastic composite pipes

On-site products

Reinforced concrete pipes and shield pipes

Reinforced concrete pile



Hume tube

C1427

(W82)Sewerage(Pipe cross-sectional shape)

(W82)Sewerage(Pipe cross-sectional shape)

Sewerage

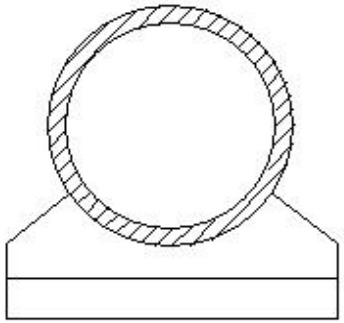
・Sewerage planning

Pipeline facilities

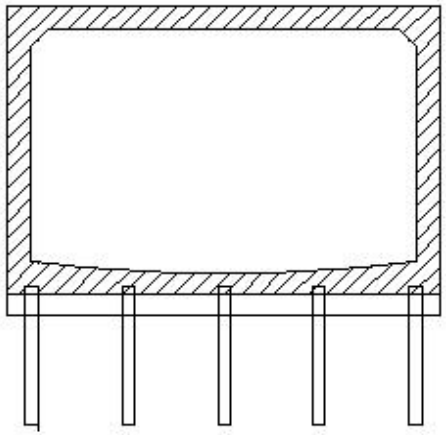
・Types of pipes

② Pipe cross-sectional shape

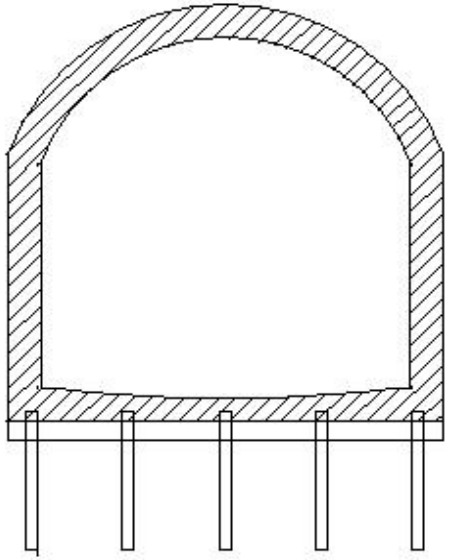
Circular pipe



Rectangular pipe



Horseshoe pipe



(W83)Sewerage(Planned sewage volume)

(W83)Sewerage(Planned sewage volume)

Sewerage

・Sewerage planning

Pipeline facilities

・Types of pipes

②Planned sewage volume

・Sewage pipe: Maximum sewage volume in planned time (planned sewage volume)

・Storm sewer pipe

Q=1/360C・I・A

Q: Planned storm water volume (m3/s)

C: Runoff coefficient: 0.55

I: Rainfall intensity (mm/h)

A: Drainage area (ha: hectares): 60ha

Inflow time: 8 minutes

Flow down time: 6 minutes

a=6000

b=38

I=a/(t+b)

I=6000／（(8＋6)＋38）=6000/52＝115mm/h

Sewerage

Q=1/360C・I・A

Q=1/360×0.55×115×60＝10.5　10.5m3／s

(W84)Sewerage(Flow rate calculation and cross-section determination)

(W84)Sewerage(Flow rate calculation and cross-section determination)

Sewerage

・Sewerage planning

Pipeline facilities

・Types of pipes

③Flow rate(discharge) calculation and cross-section determination

・Flow rate(discharge) calculation and cross-section determination

Manning's formula

$V=1/nR^{2/3}\cdot I^{1/2}$

n: Roughness coefficient (surface roughness)

R: Diameter and depth

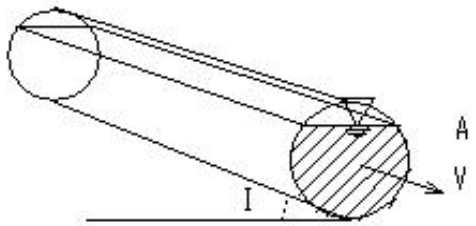
I: Gradient

$Q=V\cdot A$

Q: Flow rate(discharge) m3/s

V: Flow velocity m/s

A: Area m2



(W85)Sewerage(Pipeline Facilities)

(W85)Sewerage(Pipeline Facilities)

sewer

・Sewerage planning

Pipeline Facilities

・Type of pipe

・Circular pipe: Full water (maximum flow rate when the water depth is 95%)

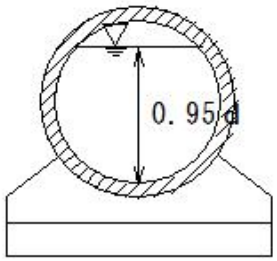
・Rectangle 90% water depth

・Horseshoe-shaped 80% water depth

Maximum flow rate(discharge)

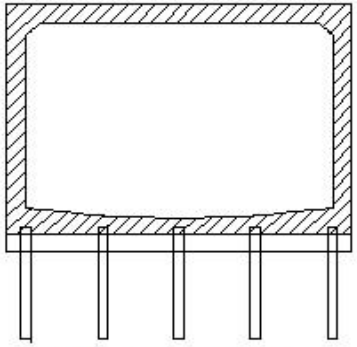
0.95 d

Circular pipe



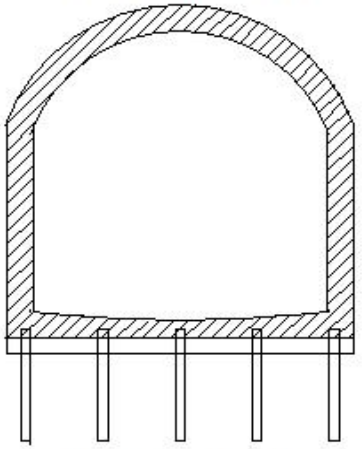
water depth 95%

Rectangular pipe



90% water depth

Horseshoe pipe



80% water depth

W82

(W86)Sewerage(Type of pipe)

(W86)Sewerage(Type of pipe)

sewer

・Sewerage planning

Pipeline Facilities

・Type of pipe

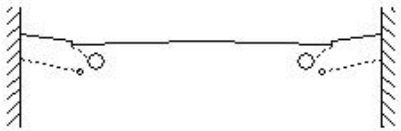
Minimum Pipe Diameter

Sewage pipe 200mm

Rain Water pipe 250mm

Confluence pipe 250mm

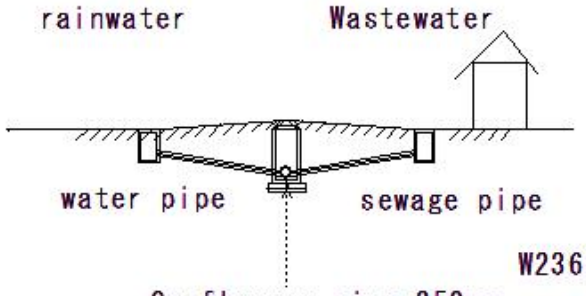
separate system



W261

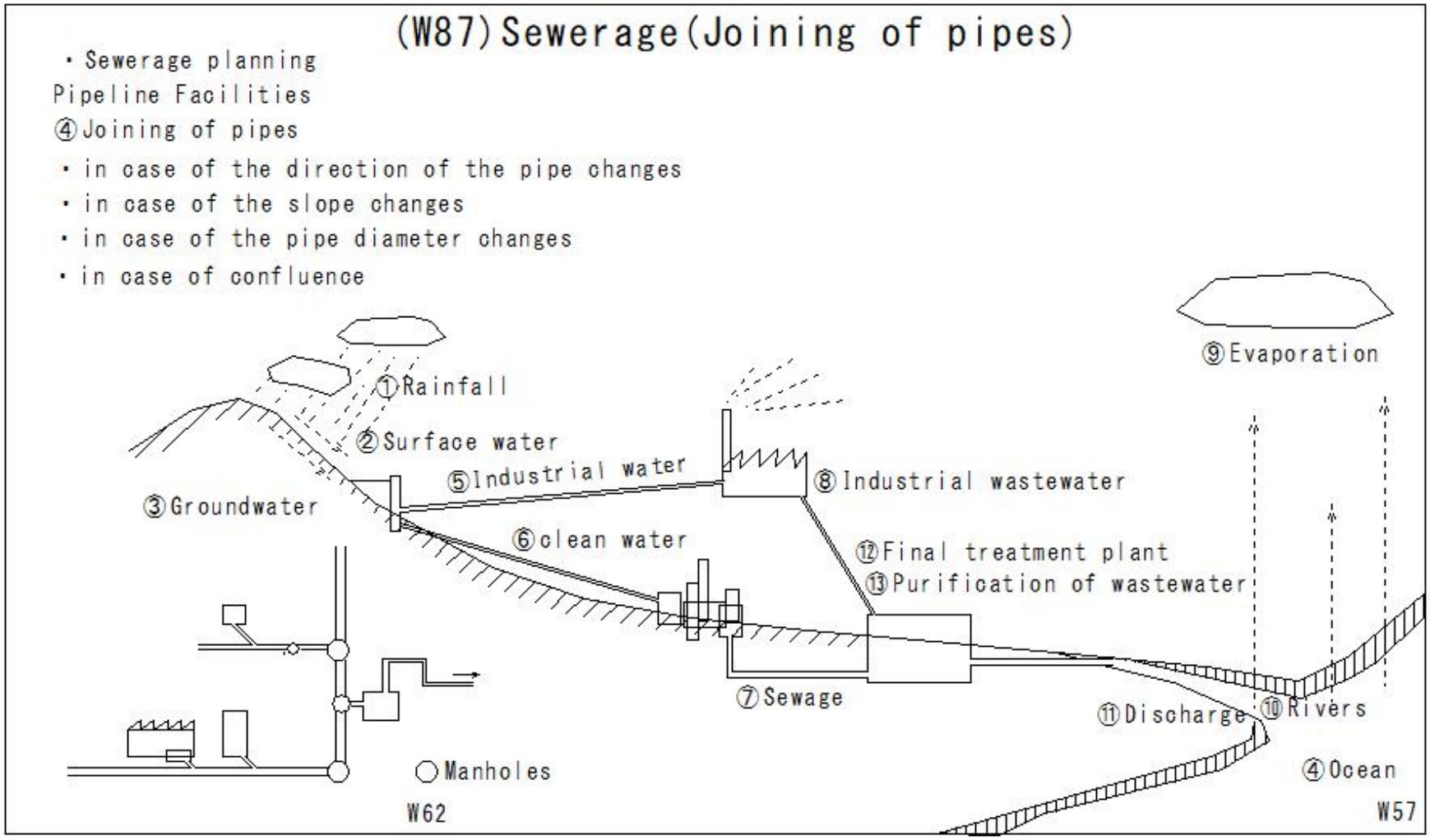
○: Large circle: water pipe
◦: Small circle: sewage pipe

combined system



W236

(W87)Sewerage(Joining of pipes)



(W88)Sewerage(Types of pipe joints)

(W88)Sewerage(Types of pipe joints)

sewer

・Sewerage planning

Pipeline Facilities

⑤Types of pipe joints

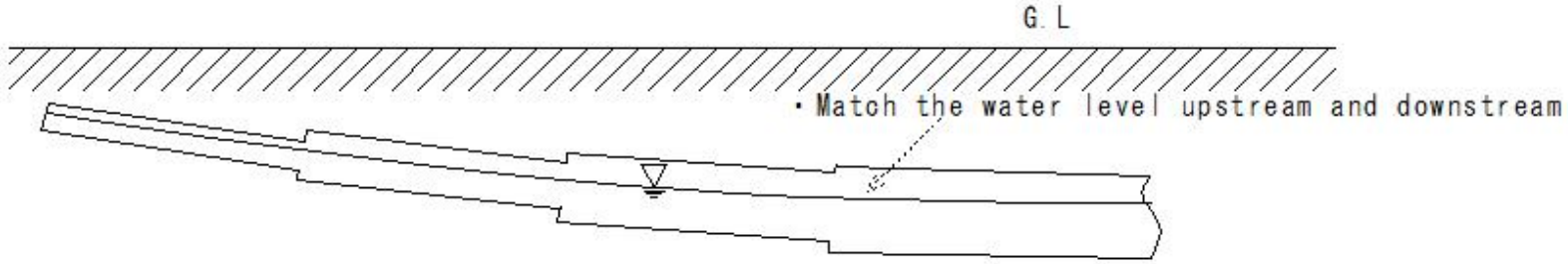
Types, shapes, and characteristics of joints according to changes in pipe diameter

①Water Surface joint

・Match the water level upstream and downstream

・Rational

・ Troublesome calculation



①Water Surface joint

(W89)Sewerage(Types of pipe joints)

(W89)Sewerage(Types of pipe joints)

Sewerage

・Sewerage planning

Pipeline facilities

⑤Types of pipe joints

Types, shapes, and features of joints according to changes in pipe diameter

②Pipe top joint

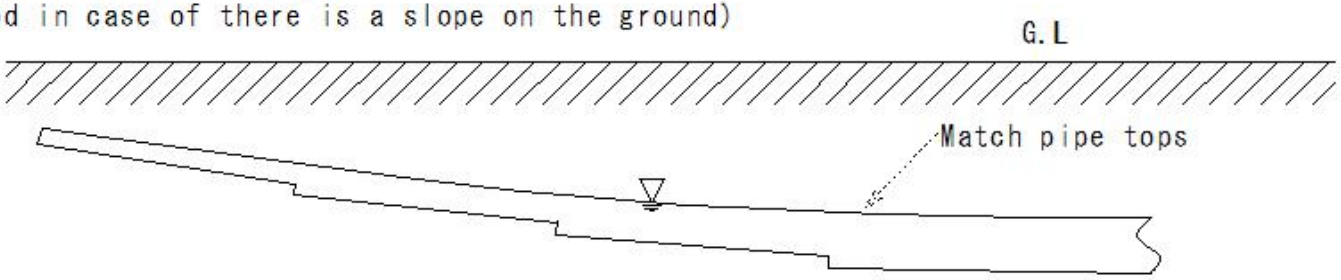
Match pipe tops

・Match the height of the inner top of the pipe

・Easy to calculate

・Pipes are buried deeper

(Good in case of there is a slope on the ground)



②Pipe top joint

(W90)Sewerage(Types of pipe joints)

(W90)Sewerage(Types of pipe joints)

Sewerage

・Sewerage planning

Pipeline facilities

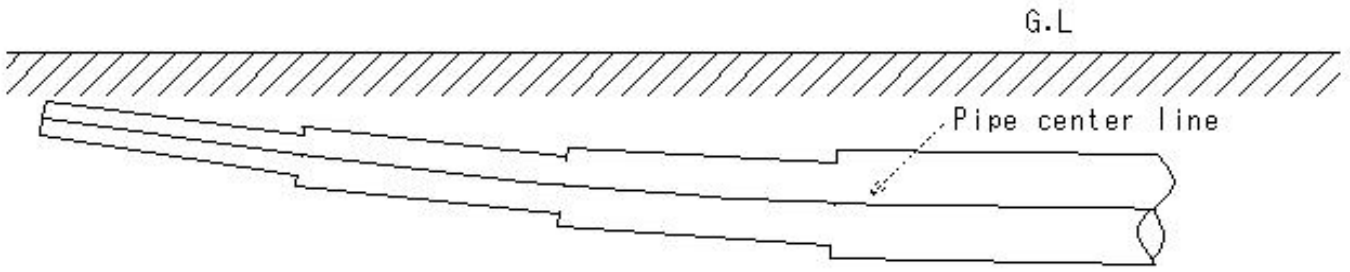
⑤Types of pipe joints

Types, shapes, and characteristics of joints according to changes in pipe diameter

③Pipe center joint

・Make the center height of the pipe the same

・Center of ① and ②



③Pipe center joint

(W91)Sewerage(Types of pipe joints)

(W91)Sewerage(Types of pipe joints)

Sewerage

・Sewerage planning

Pipeline facilities

⑤Types of pipe joints

Types, shapes, and features of joints according to changes in pipe diameter

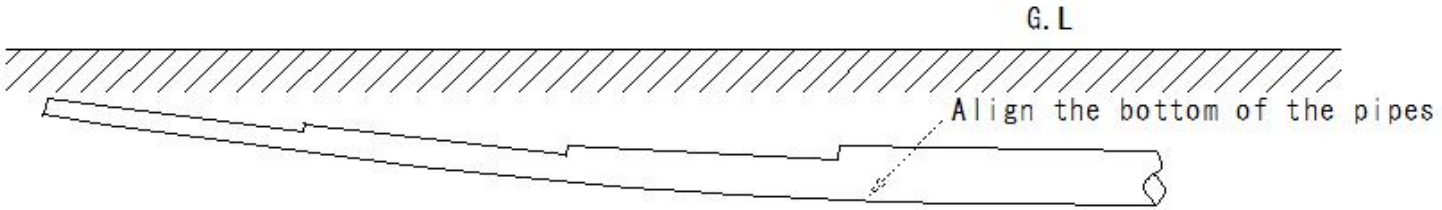
④Low pipe joints

・Align the bottom of the pipes

・Pipes are buried to a small depth

・Poor hydraulic conditions upstream

・Suitable for pump drainage areas



④Low pipe joints

(W92)Sewerage(Types of pipe joints)

(W92)Sewerage(Types of pipe joints)

sewer

・Sewerage planning

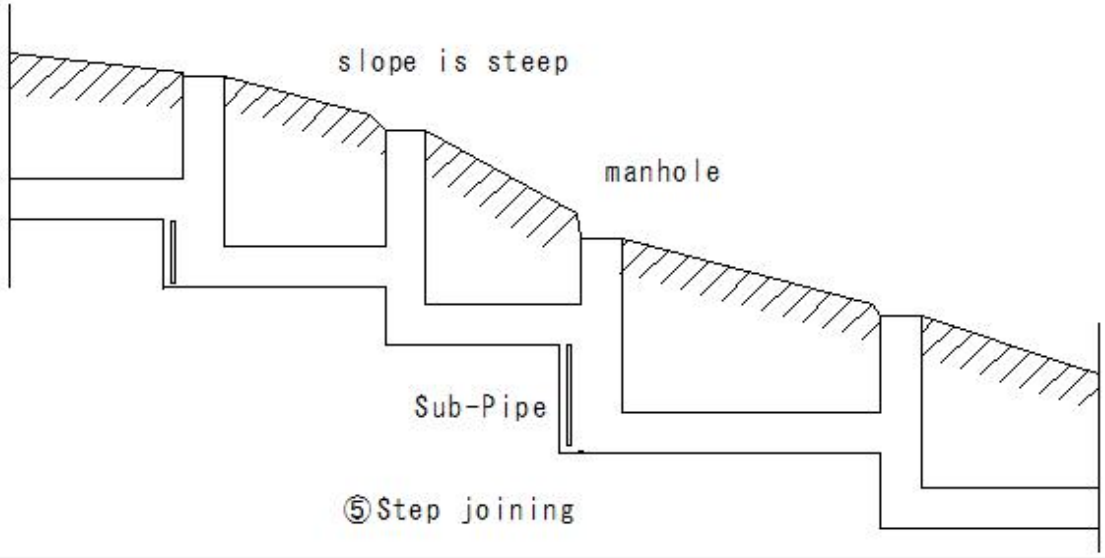
Pipeline Facilities

⑤Types of pipe joints

Types, shapes, and characteristics of joints according to changes in pipe diameter

⑤Step joining

in case of the ground surface slope is steep, steps are used to join



(W93)Sewerage(Types of pipe joints)

(W93)Sewerage(Types of pipe joints)

sewer

・Sewerage planning

Pipeline Facilities

⑤Types of pipe joints

Types, shapes, and characteristics of joints according to changes in pipe diameter

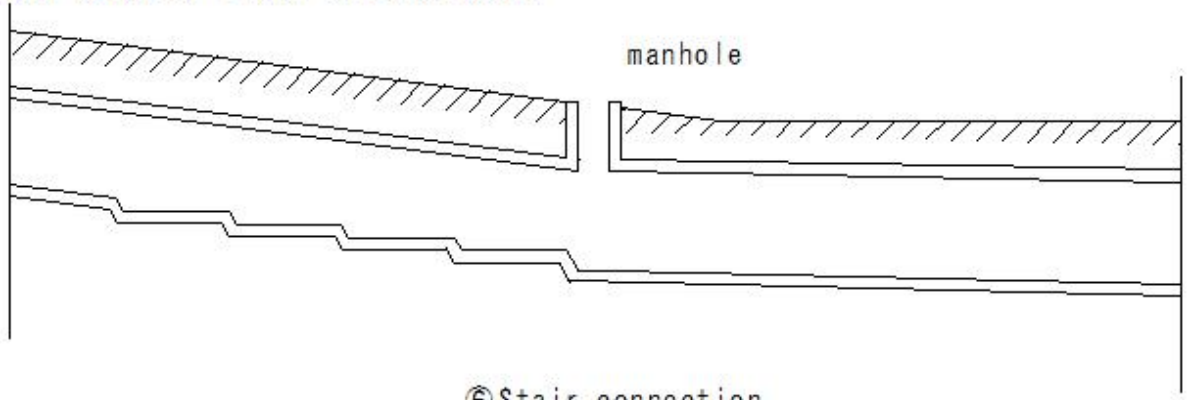
⑥Stair connection

・in case of the slope of the ground is steep

Tonality of flow velocity

Maintain a minimum soil cover

・Pipe top joint or water surface joint



⑥Stair connection

(W94)Sewerage(inverted siphon(Underpass))

(W94)Sewerage(inverted siphon(Underpass))

Sewerage

Sewerage planning

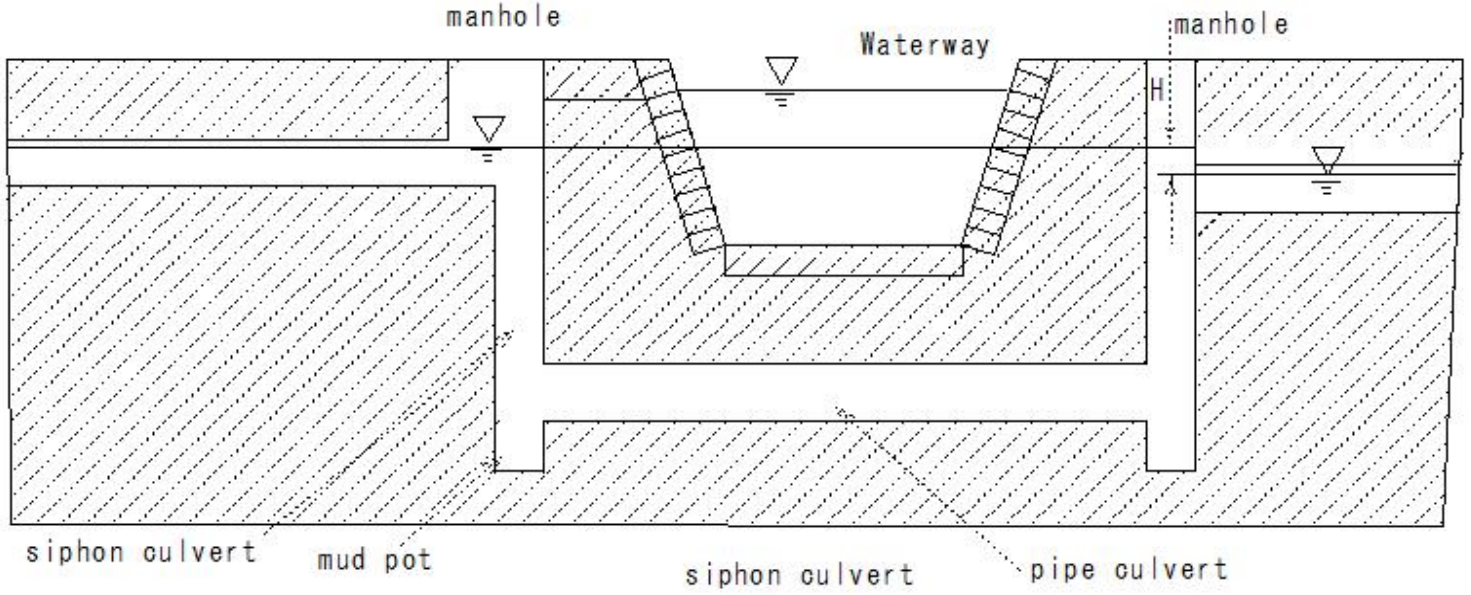
Pipeline facilities

⑤Types of pipe joints

Types, shapes, and characteristics of joints according to changes in pipe diameter

⑦inverted siphon(Underpass)

Passing under a structure as a pressure pipe



R612
R271

(W95)Sewerage(Pipe joints)

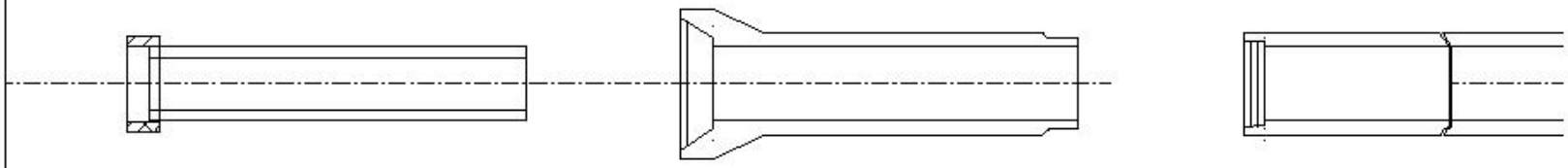
(W95) Sewerage (Pipe joints)

Sewerage

Sewerage planning

Pipeline facilities

⑥ Pipe joints



① Collar joints

② Socket joints

③ Spigot joints

(W96)Sewerage(Foundation work)

(W96)Sewerage(Foundation work)

Sewerage

・Sewerage planning

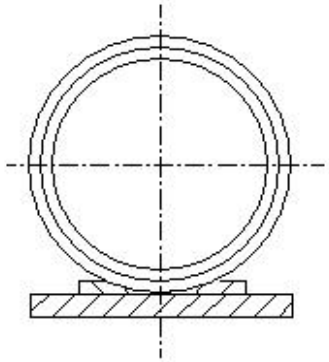
Pipeline facilities

⑦Foundation work

①cap beam

・Normal ground

・Sufficient backfilling under the pipe



①cap beam

(W97)Sewerage(Foundation work)

(W97)Sewerage(Foundation work)

Sewerage

・Sewerage planning

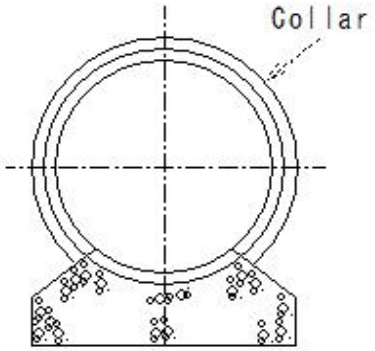
Pipeline facilities

⑦Foundation work

②Sand foundation, gravel foundation, split stone foundation

・Used on soft ground

・Disperses force



①cap beam

②Sand foundation, gravel foundation, split stone foundation

(W98)Sewerage(Foundation work)

(W98) Sewerage (Foundation work)

Sewerage

Sewerage planning

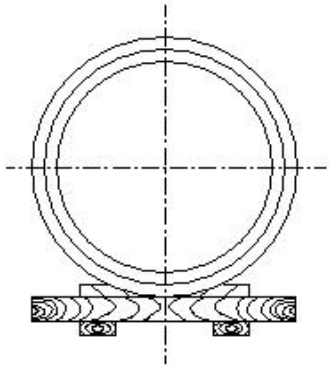
Pipeline facilities

⑦ Foundation work

③ Ladder beam foundation

Used for soft soil with spring water

Filling the gaps between the ladder bars with gravel



③ Ladder beam foundation

(W99)Sewerage(Foundation work)

(W99) Sewerage (Foundation work)

Sewerage

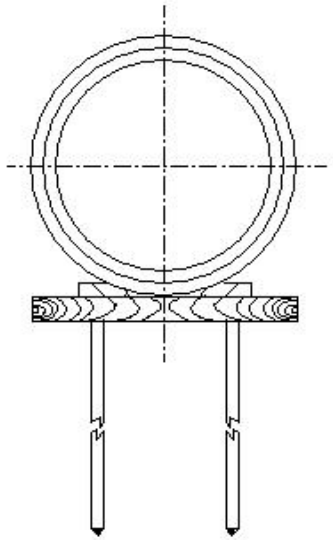
Sewerage planning

Pipeline facilities

⑦ Foundation work

④ Pile-driven cap beam foundation

Soft ground - Subsidence (Settling Settlement) expected



④ Pile-driven cap beam foundation

(W100)Sewerage(Foundation work)

(W100)Sewerage(Foundation work)

Sewerage

sewerage planning

Pipeline facilities

⑦ Foundation work

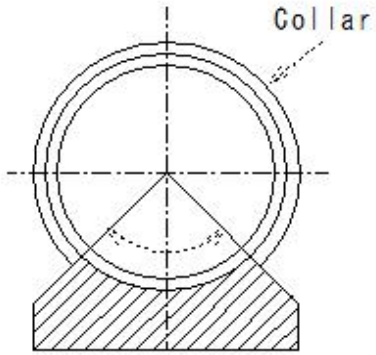
⑤ Concrete foundation

in case of the external pressure of the pipe is large

Installed to reinforce the pipe

The larger the angle of the bearing surface, the greater the strength

Use in combination with ① to ⑤



⑤ Concrete foundation

(W101)Sewerage(street inlet(rainwater catch basin))

(W101)Sewerage(street inlet(rainwater catch basin))

Sewerage

Sewerage planning

Pipeline facilities

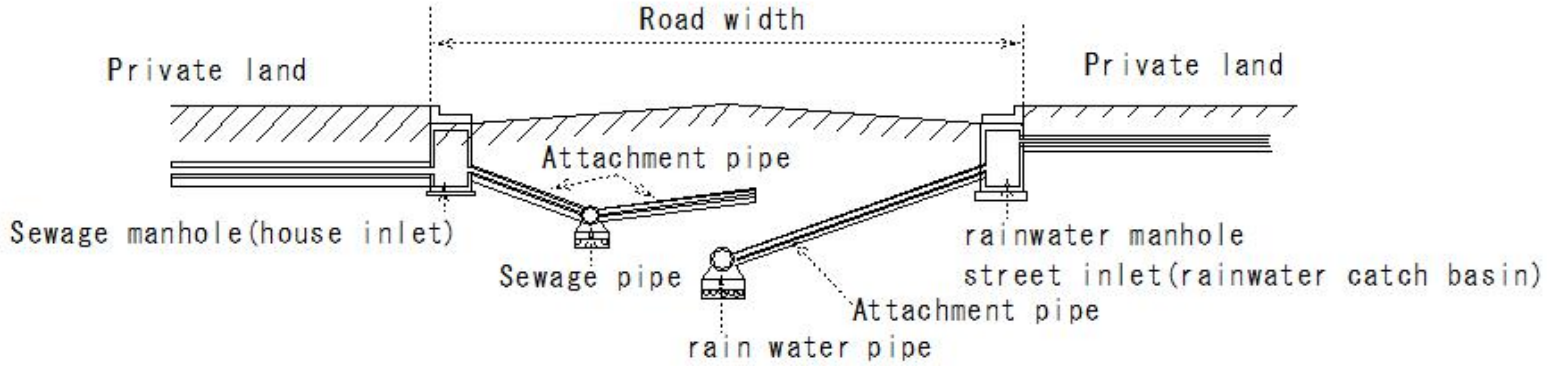
⑧street inlet(rainwater catch basin)

Install at the location where the sidewalk and roadway are separated

Install at 30m intervals

Make it easy for rainwater to enter

install a mud catchment



Standard layout diagram for separate pipe

(W102)Sewerage(Sewage manhole(house inlet))

(W102)Sewerage(Sewage manhole(house inlet))

Sewerage

Sewerage planning

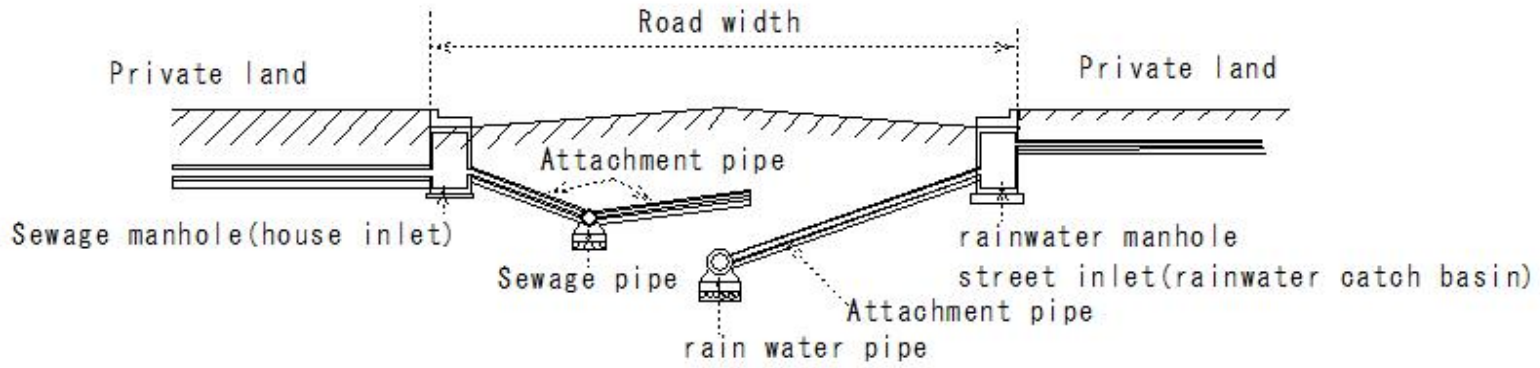
Pipeline facilities

⑨Sewage manhole(house inlet)

Bottom of sewage manhole - Install an invert

Sewage is sent out

Install a cast iron or reinforced concrete cover to prevent odors



Standard layout diagram for separate pipe

(W103)Sewerage(Attachment pipe)

(W103)Sewerage(Attachment pipe)

Sewerage

Sewerage planning

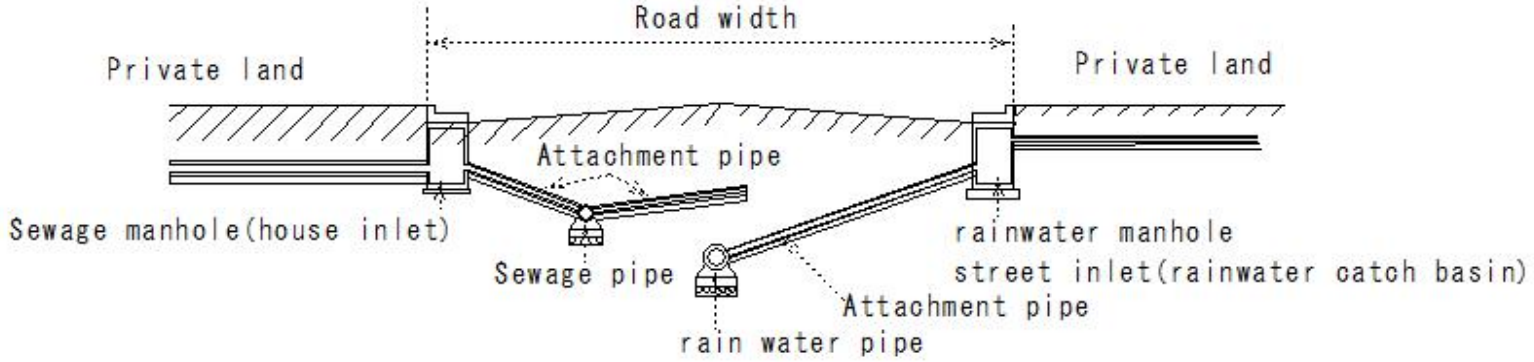
Pipe facilities

⑩Attachment pipe

A pipe connecting the manhole and sewer pipe

Pipe diameter 150-200mm

Slope 1/100 or more



Standard layout diagram for separate pipe

(W104)Sewerage(Construction of pipes-Soil survey)

(W104)Sewerage(Construction of pipes-Soil survey)

Construction of pipes

Soil survey

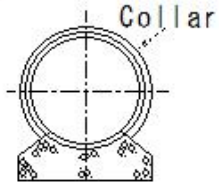
①Selection of pipe foundation work (sand, gravel, ladder beam, concrete)

②Selection of construction method (open cut method, jacking method, shield method)

③Earth retaining method (wooden sheet pile, lightweight steel sheet pile, steel sheet pile, H-shaped steel horizontal sheet pile)

④Design of roadbed, road base, and pavement in case of restoring roads

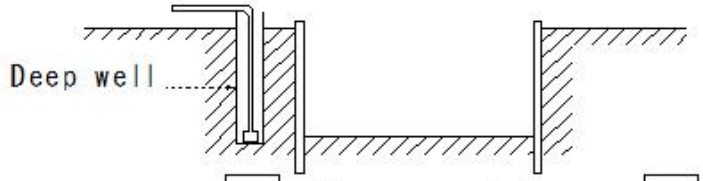
①Foundation work



①cap beam

W97

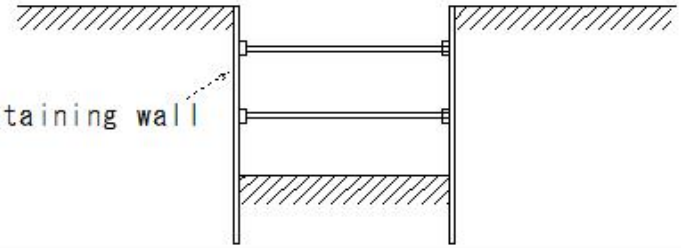
②open cut method,



Open cut method

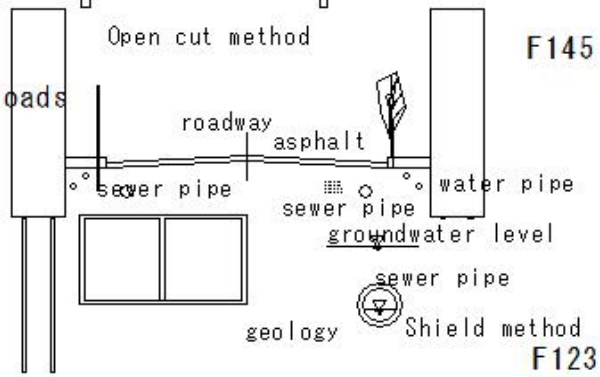
F145

③Earth retaining method



F85

④ restoring roads



F123

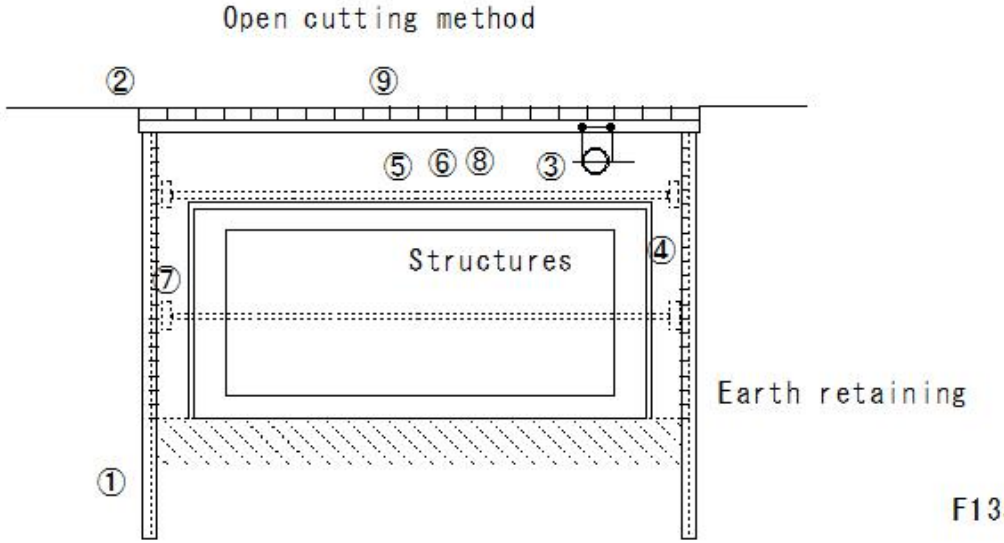
(W105)Sewerage(open cut method)

(W105)Sewerage(open cut method)

Pipe construction

Construction sequence for open cut and cover method

①Pile driving
②Road surface lining
③Protection of buried objects
④Earth retaining shoring
⑤Records of excavation, reinforcing cage installation, and concrete placement
⑥Construction
⑦Waterproof
⑧Backfilling
⑨Road lining removal



F133

(W106)Sewerage(open cut method-Wooden sheet pile method)

(W106)Sewerage(open cut method-Wooden sheet pile method)

Pipe construction

①Types of retaining works

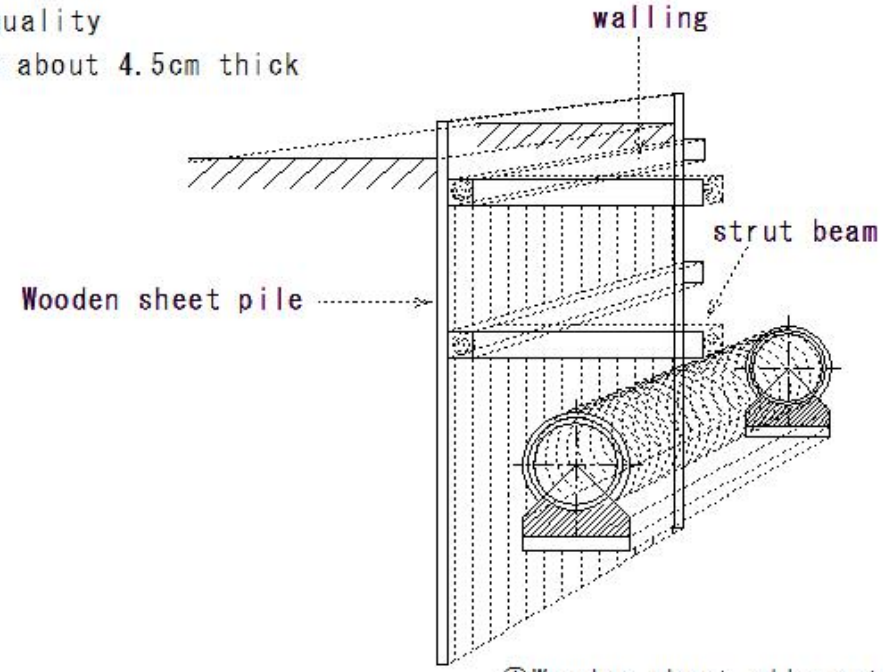
①Wooden sheet pile method

Used for small and medium diameter pipe construction

Shallow excavation

Good soil quality

Pine boards about 4.5cm thick



①Wooden sheet pile method

(W107)Sewerage(open cut method-Lightweight steel sheet pile method)

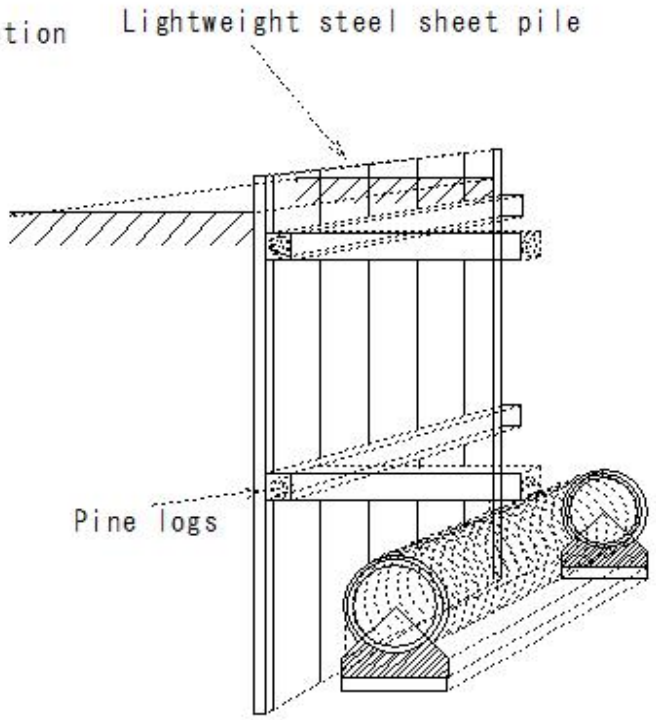
(W107)Sewerage(open cut method-Lightweight steel sheet pile method)

Pipe construction

①Types of retaining wall

②Lightweight steel sheet pile method

・Used for small and medium-sized pipe construction
・Economical as it can be reused
・Easy to handle
・Easy to deform



②Lightweight steel sheet pile method

(W108)Sewerage(open cut method-Steel sheet pile construction method)

(W108)Sewerage(open cut method-Steel sheet pile construction method)

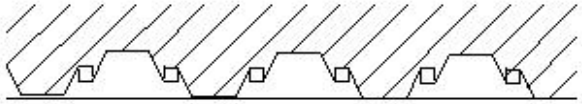
Construction of pipes

①Types of mountain retaining work

③Steel sheet pile construction method

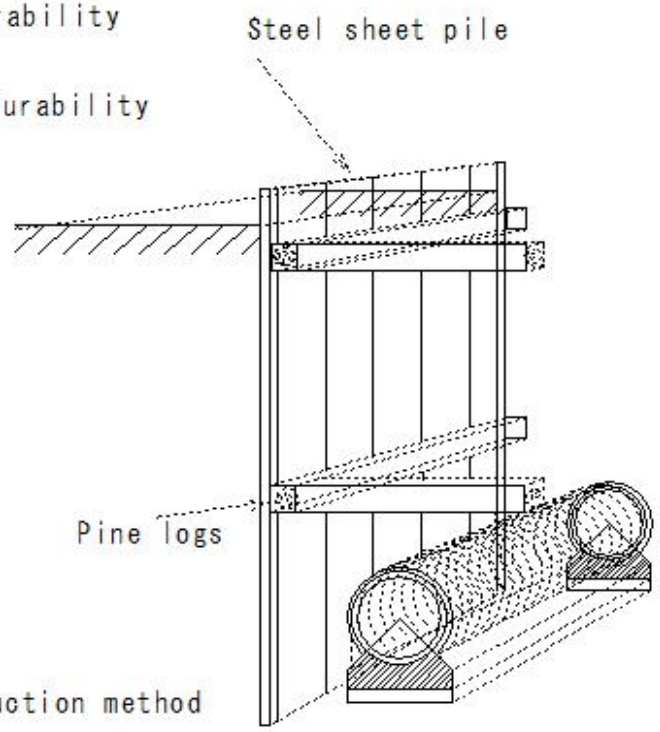
- Large-scale construction with a large excavation depth
- Steel sheet pile - good strength, watertightness, and durability
- Large-scale construction with a large excavation depth
- Steel sheet pile - proper strength, watertightness, and durability

Requires heavy machinery
Handling - difficult



・Steel sheet pile method

F342



③Steel sheet pile construction method

(W109)Sewerage(open cut method- H-beam sheet pile construction method)

(W109)Sewerage(open cut method- H-beam sheet pile construction method)

Construction of pipes

①Types of Earth retaining work

④H-beam sheet pile construction method

・H or I beams are driven into intervals of 1.5-2.0m.

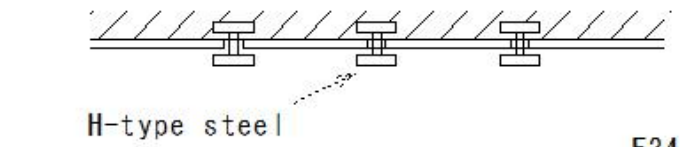
Fit the horizontal sheet pile at the same time as excavation

・Used in case of steel sheet piles cannot be cast continuously.

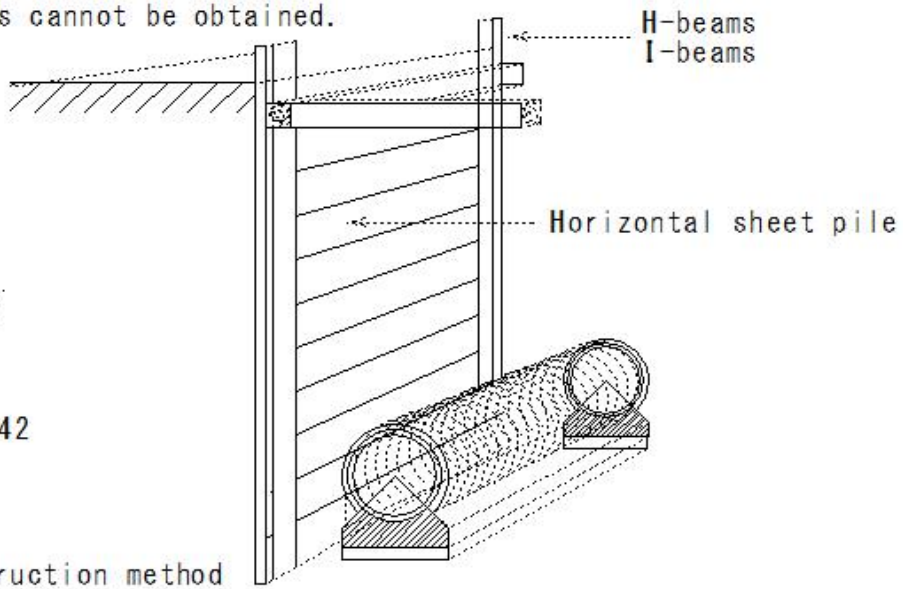
・Used for geology where steel sheet piles cannot be driven

・There is a disadvantage that watertightness cannot be obtained.

Unable to prevent heaving



F342



④H-beam sheet pile construction method

(W110)Sewerage(Pipe construction/Cast-in-place mortar piles)

(W110)Sewerage(Pipe construction/Cast-in-place mortar piles)

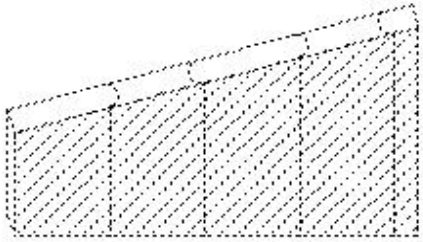
Pipe construction

① Types of retaining wall construction

⑤ Cast-in-place mortar piles

・in case of steel sheet piles cannot be driven in due to gravel layers, etc.

・Noiseless, vibration-free construction method



Cast-in-place reinforced concrete wall

F142

・Continuous underground wall construction method

(1) Pillars and pillars

(2) Pillars and walls

(3) Walls and walls

⑤ Cast-in-place mortar piles

F142

(W111)Sewerage(Covering, excavation and backfilling-Covering)

(W111)Sewerage(Covering, excavation and backfilling-Covering)

Pipe construction

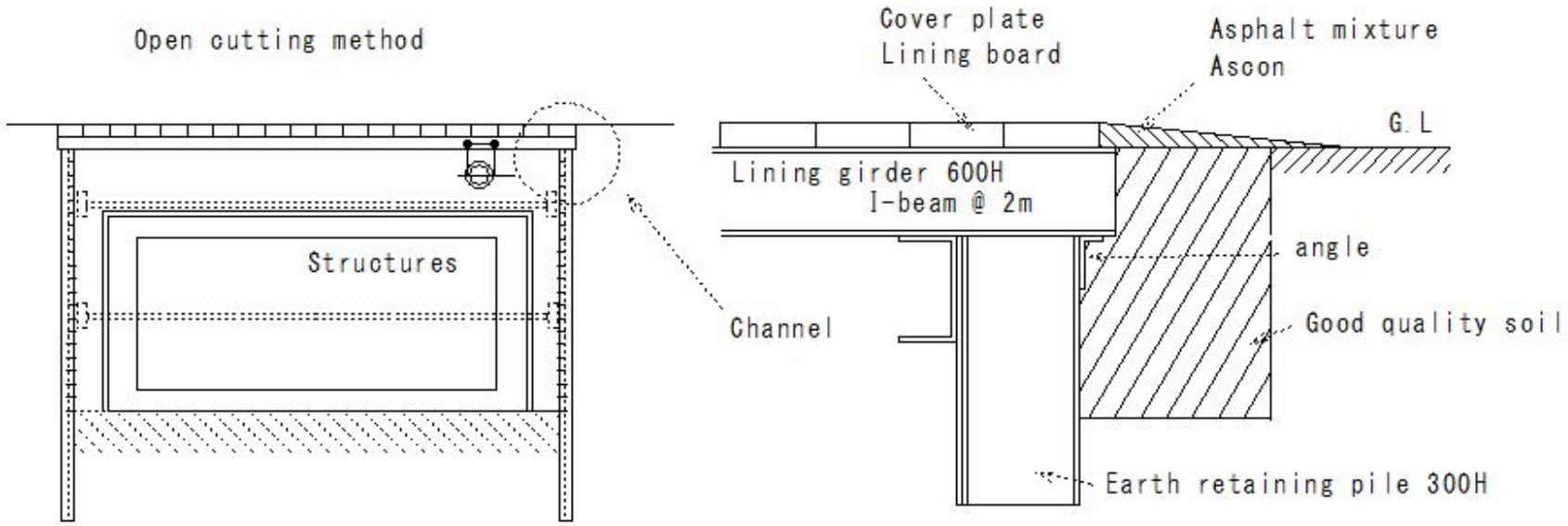
② Covering, excavation and backfilling

① Covering

Made of steel or cast iron, with asphalt applied to the surface

To prevent slipping

The difference in level between the cover plate and the road surface is fixed with asphalt mixture



F143

(W112)Sewerage(Covering, excavation and backfilling-excavation)

(W112)Sewerage(Covering, excavation and backfilling-excavation)

Construction of pipes

②Covering, excavation, and backfilling work

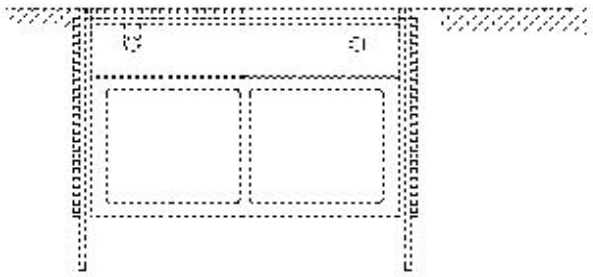
②Excavation

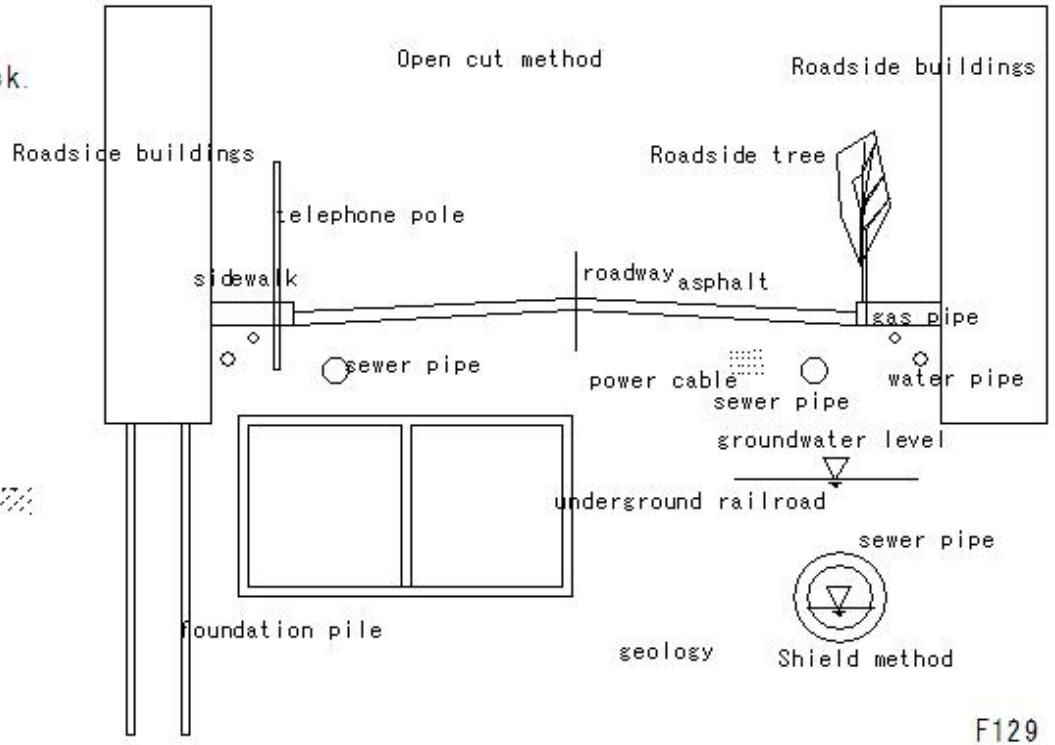
・Investigation of buried objects

・Before excavation,

do not loosen the ground on the back.

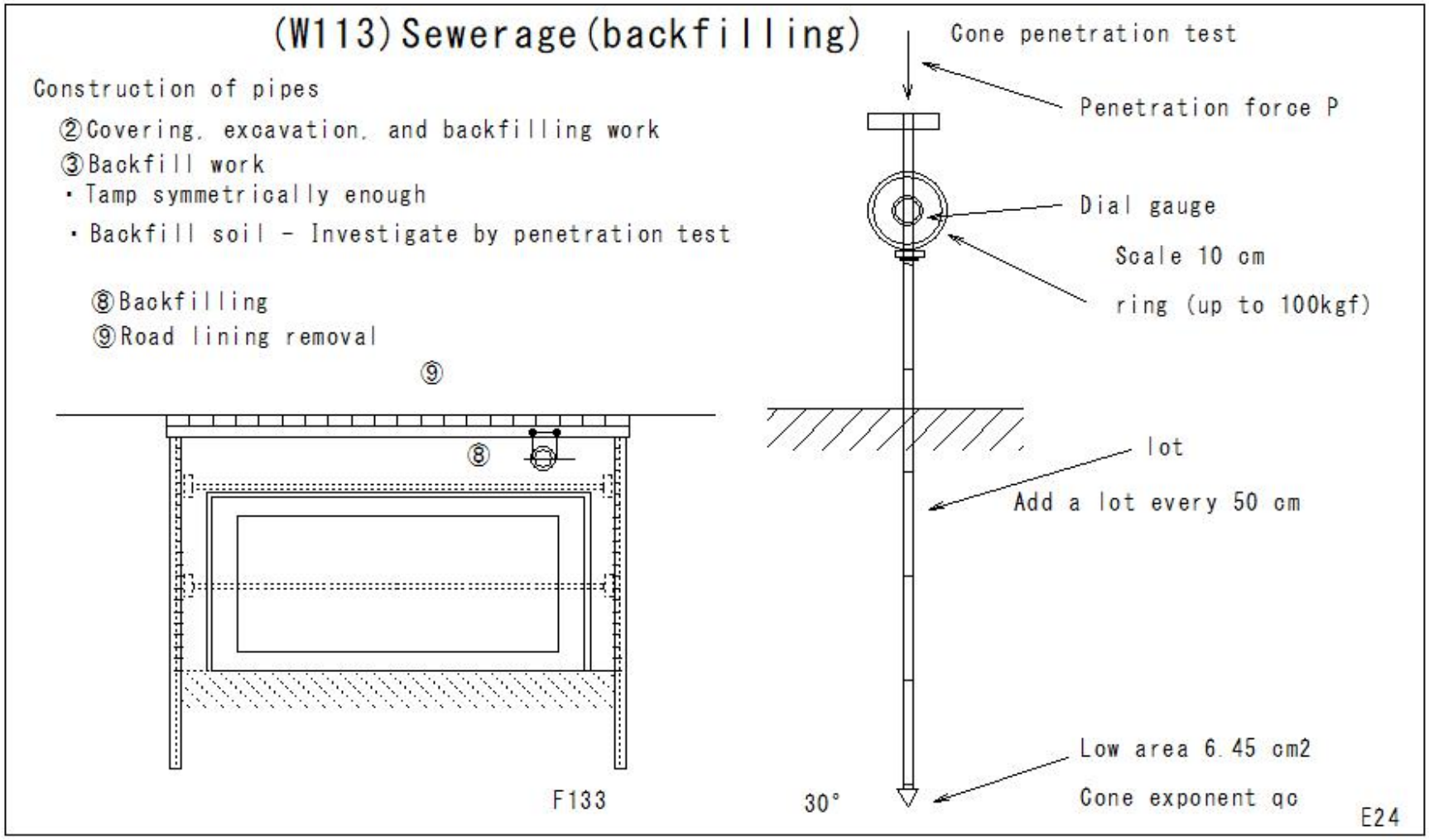
・Layered drilling





F129

(W113)Sewerage(backfilling)



(W114)Sewerage(pipe jacking method)

(W114)Sewerage(pipe jacking method)

Pipe construction

③ pipe jacking method

・Soil cover - large areas

・Open excavation - not possible

・River crossing, track crossing, major road crossing

・Shaft - 2 or more

・Start shaft - set up a jack and

・Start shaft - set up a jack and push the pipe into the mountain

・Pipe diameter - inner diameter 600mm to 2.0m

Characteristics

・Simple work equipment, low construction costs

Disadvantages

・Meandering is likely to occur

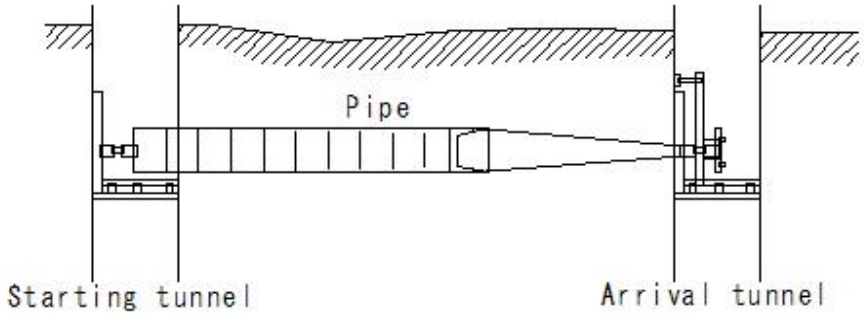
・Curved construction - difficult

・During excavation - obstacles - difficult to deal with

・Areas with a lot of groundwater - difficult to construct

Ground improvement - necessary

・During construction - ground surface subsidence(Settling) occurs



pipe jacking method(Tensioning method)

T223

(W115)Sewerage(Cutting edge driving method)

(W115)Sewerage(Cutting edge driving method)

Pipe construction

③ pipe jacking method

Types of jacking methods

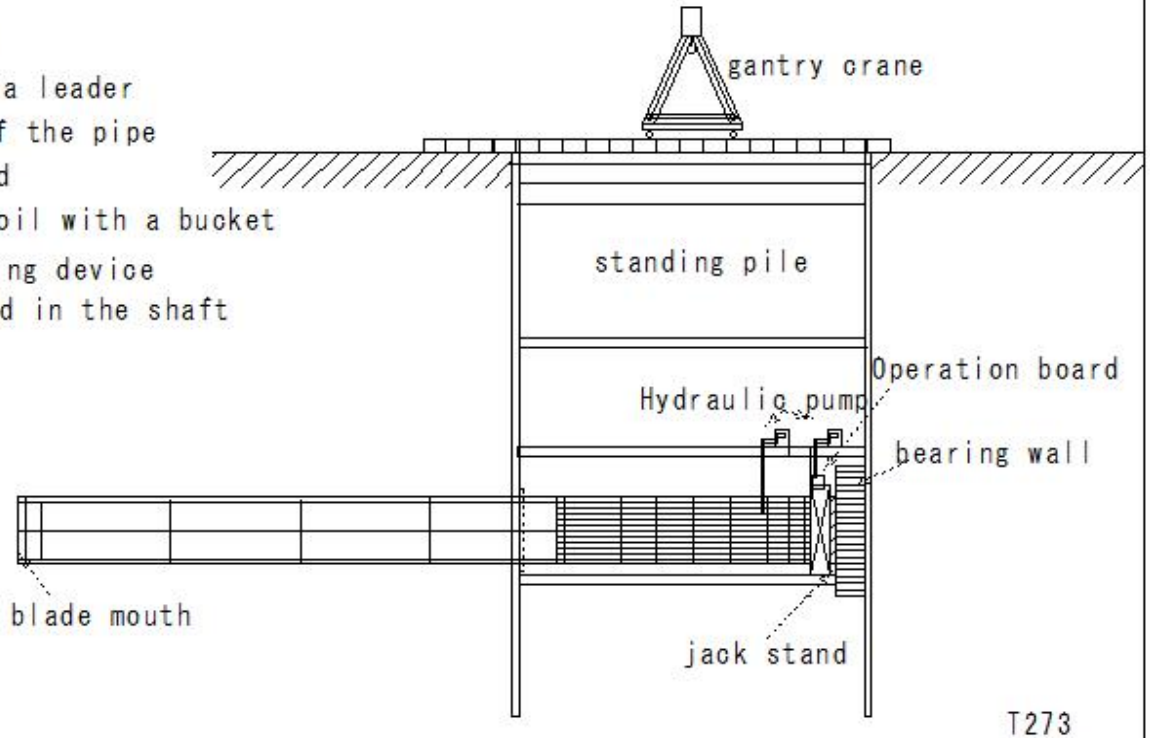
① Cutting edge driving method

・Equipped with a blade tip as a leader at the end of the pipe

・Excavating the ground by hand

・Transporting the excavated soil with a bucket

・Pushing the pipe with a jacking device installed in the shaft



T273

M396

① Cutting edge driving method

(W116)Sewerage(Semi-shield method)

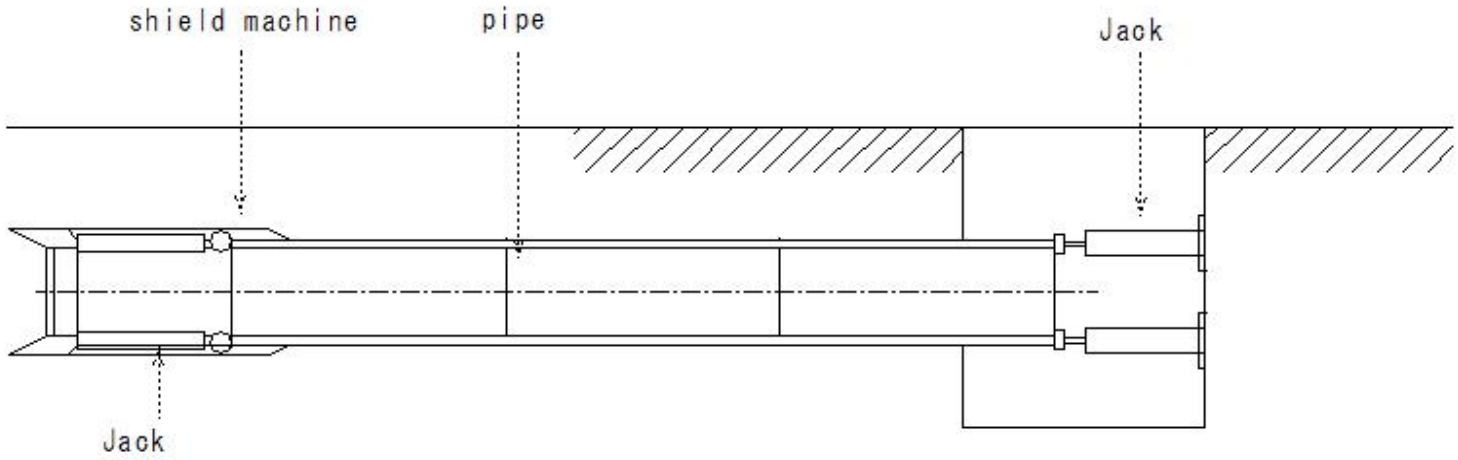
(W116)Sewerage(Semi-shield method)

Pipe construction

③ pipe jacking method

Types of jacking methods

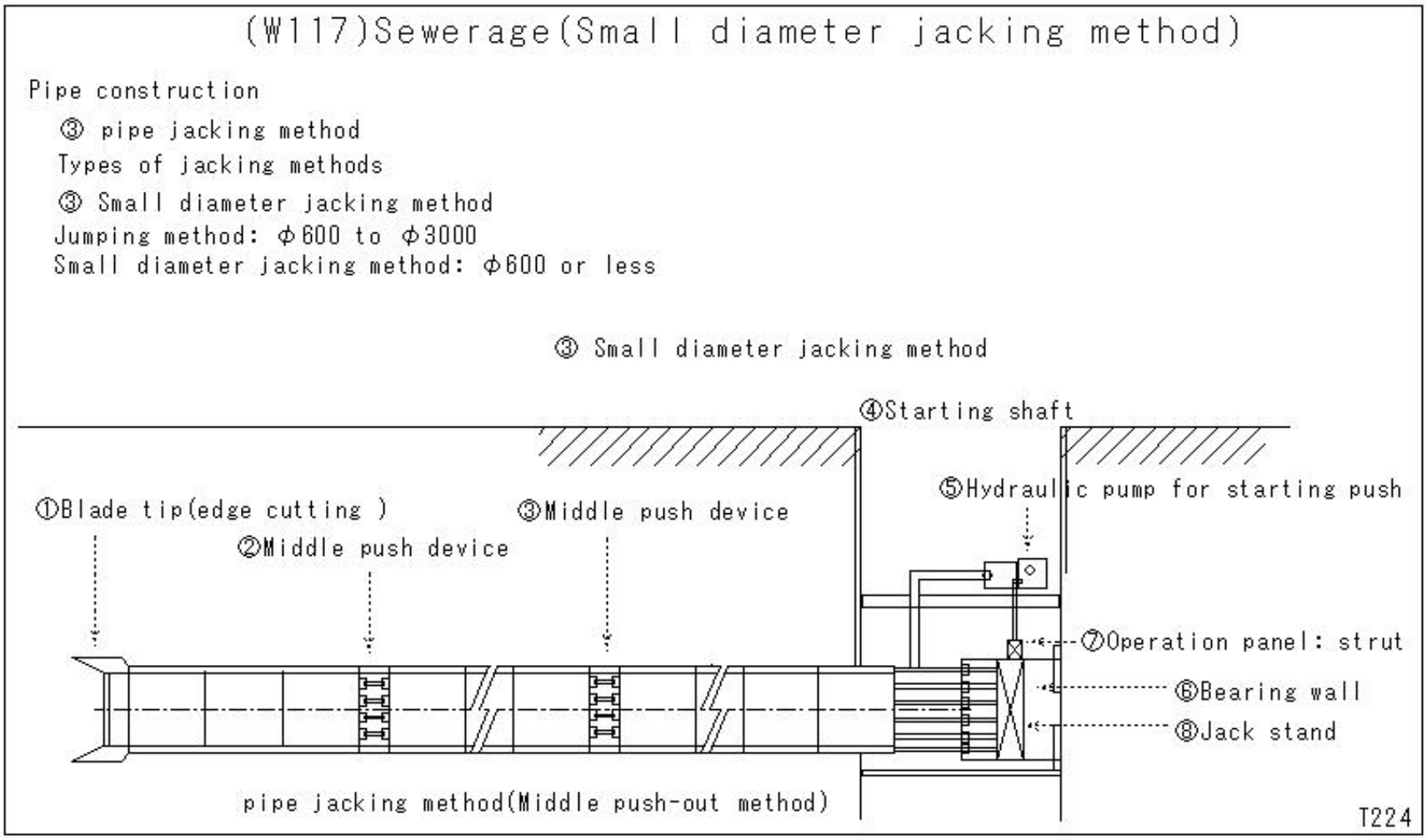
- Tip of jacking pipe - Shield jack by power
- Steerability - Maintained
- Between shield method and jacking method
- Hand-dug type・Mechanical type



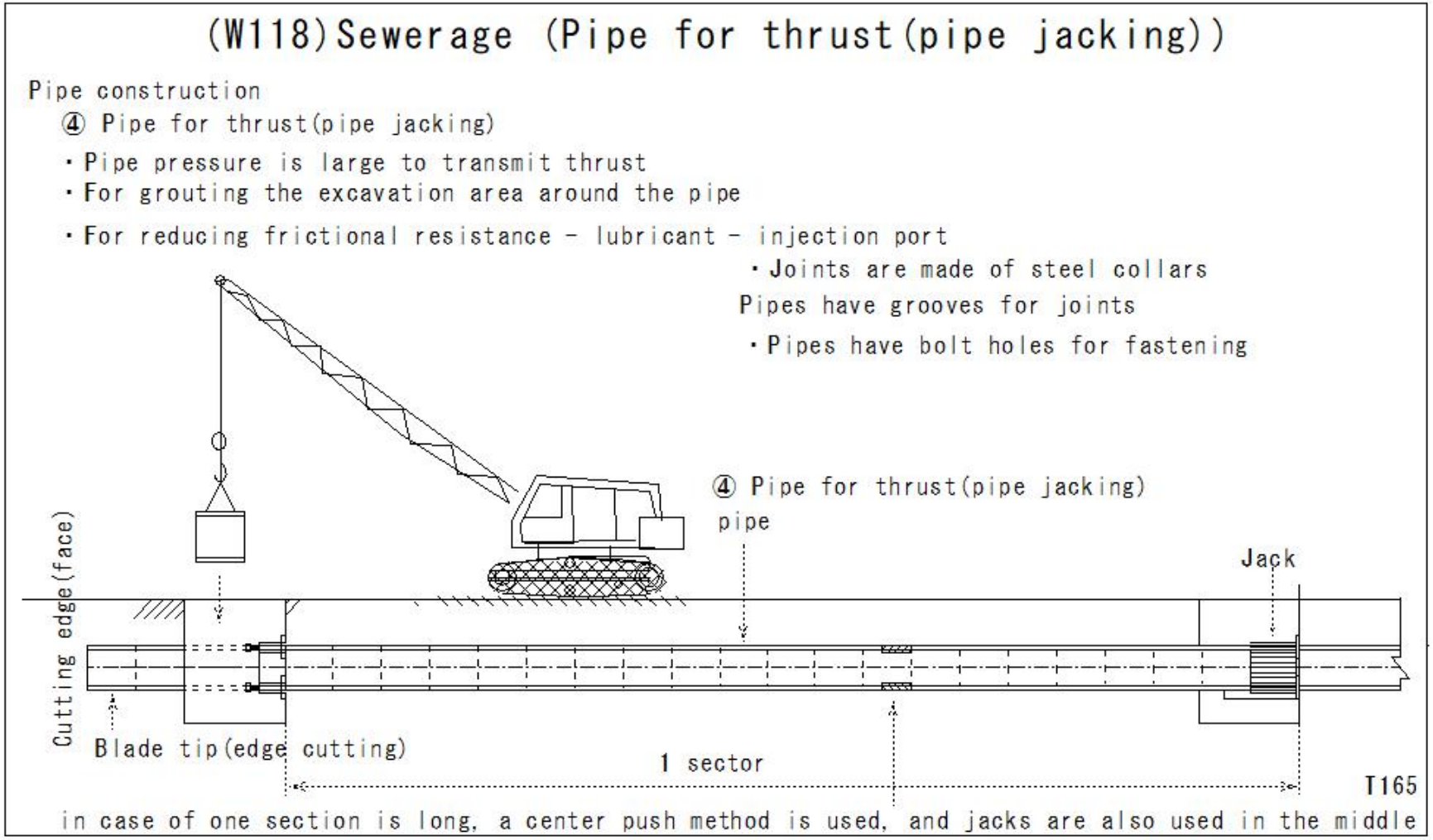
②Semi-shield method

T164

(W117)Sewerage(Small diameter jacking method)



(W118)Sewerage (Pipe for thrust(pipe jacking))



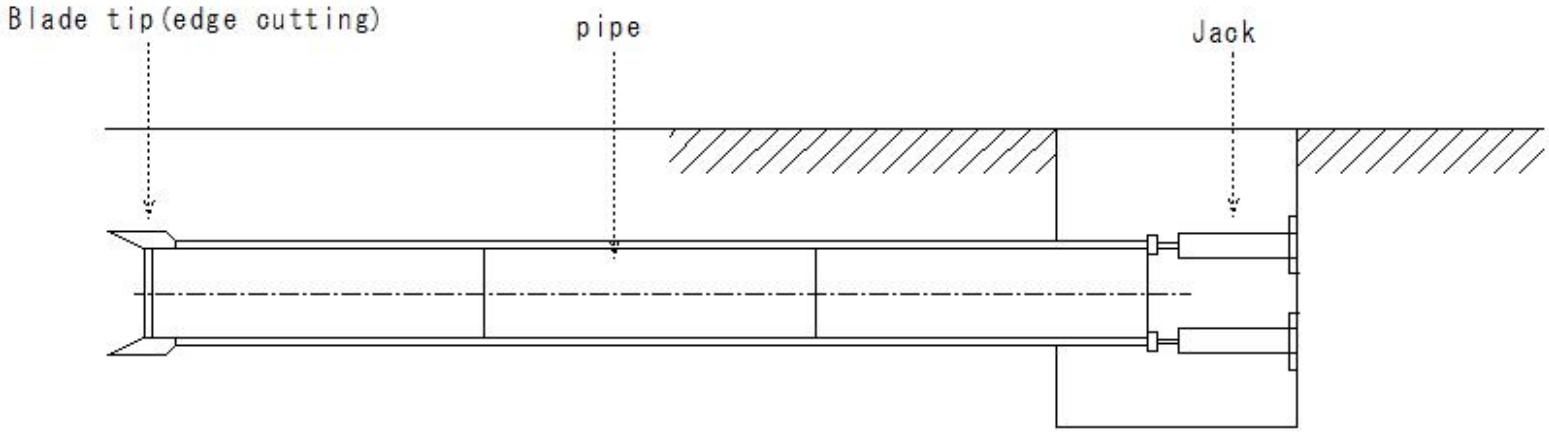
(W119)Sewerage (Improvement of pipe jacking method)

(W119)Sewerage (Improvement of pipe jacking method)

Pipe construction

⑤Improvement of pipe jacking method

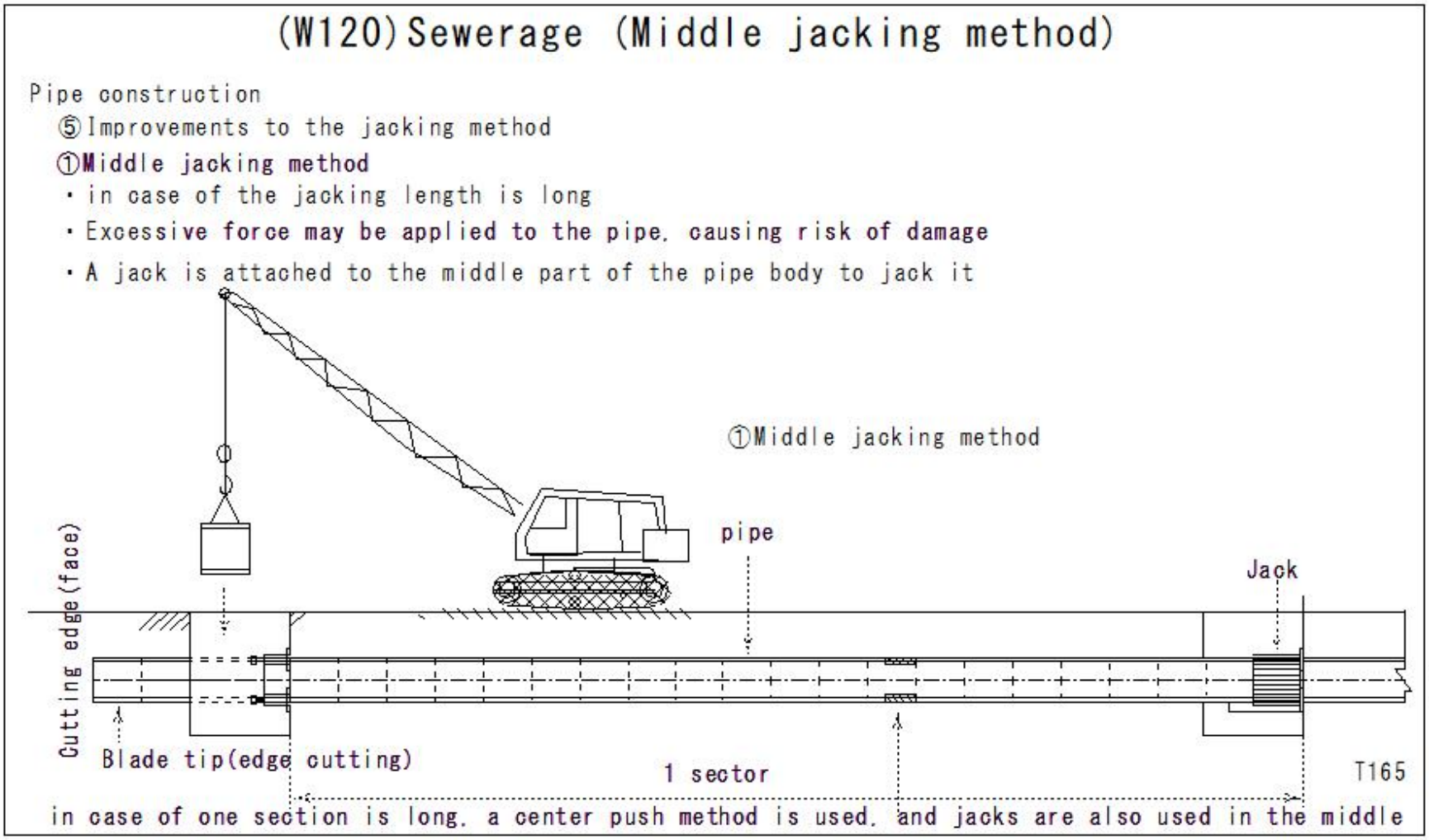
- Pump-pipe jacking
- Urban areas - less equipment required
- Increased pipe jacking length
- Improved construction accuracy
- Improvement of soft ground



edge cutting pipe jacking

T163

(W120)Sewerage (Middle jacking method)



(W121)Sewerage (Semi-shield method)

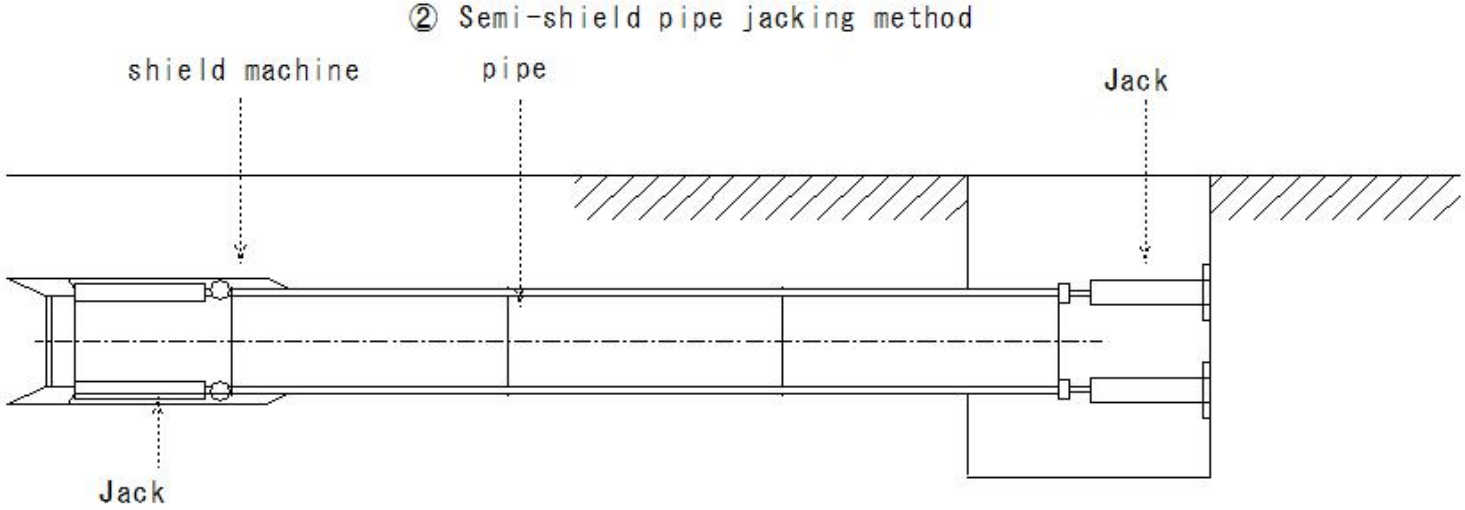
(W121)Sewerage (Semi-shield method)

Pipe construction

⑤Improvement of the tunneling method

②Semi-shield method

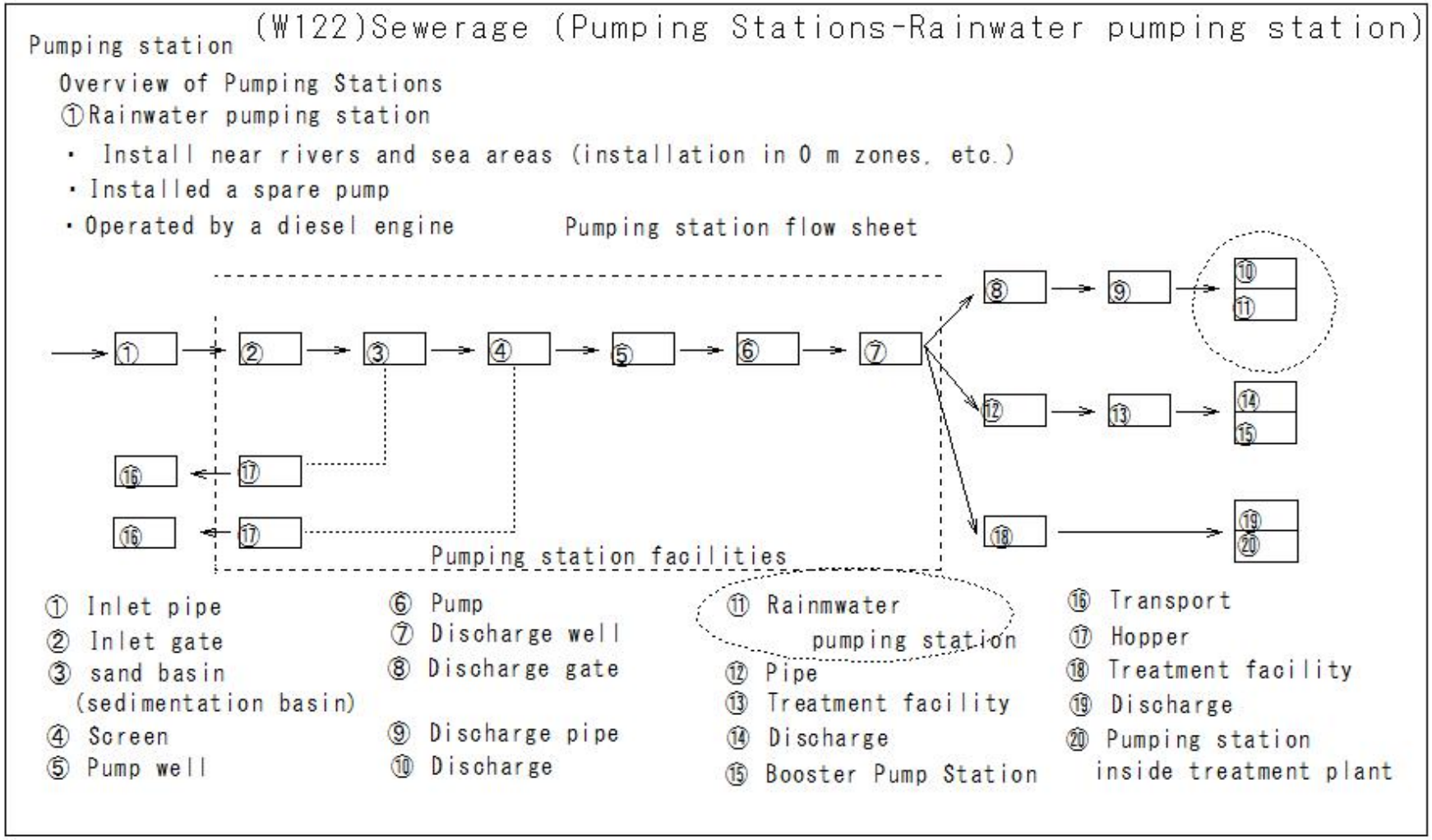
A shield is used at the cutting edge to correct the tunneling direction and improve the excavation speed



Semi-shield pipe jacking method

T164

(W122)Sewerage (Pumping Stations-Rainwater pumping station)



(W123)Sewerage (Pump Station-Booster Pump Station)

(W123)Sewerage (Pump Station-Booster Pump Station)

Pump Station

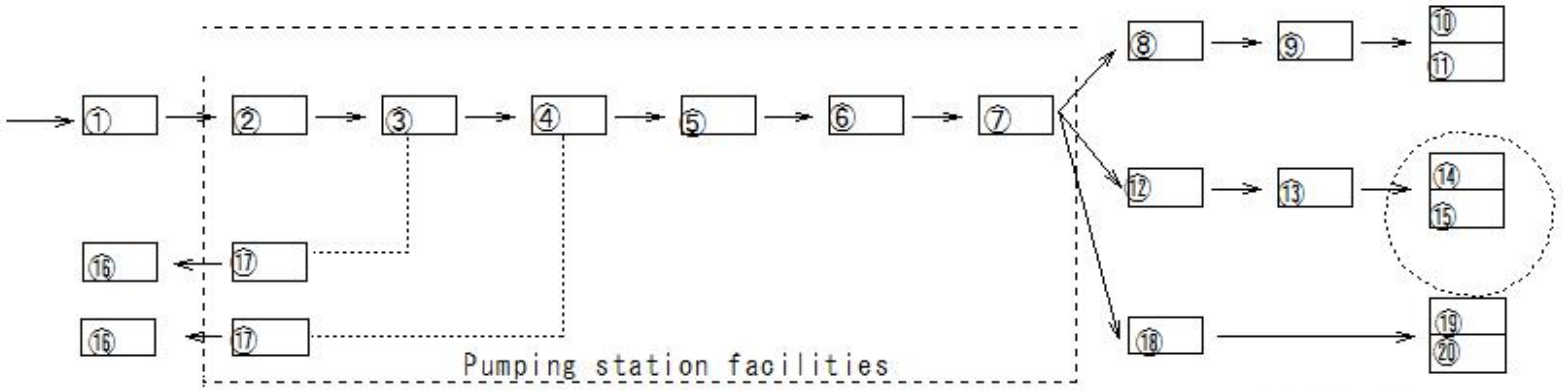
Pump Station Overview

②Booster Pump Station

・Installation location: urban area Environmental harmony - necessary

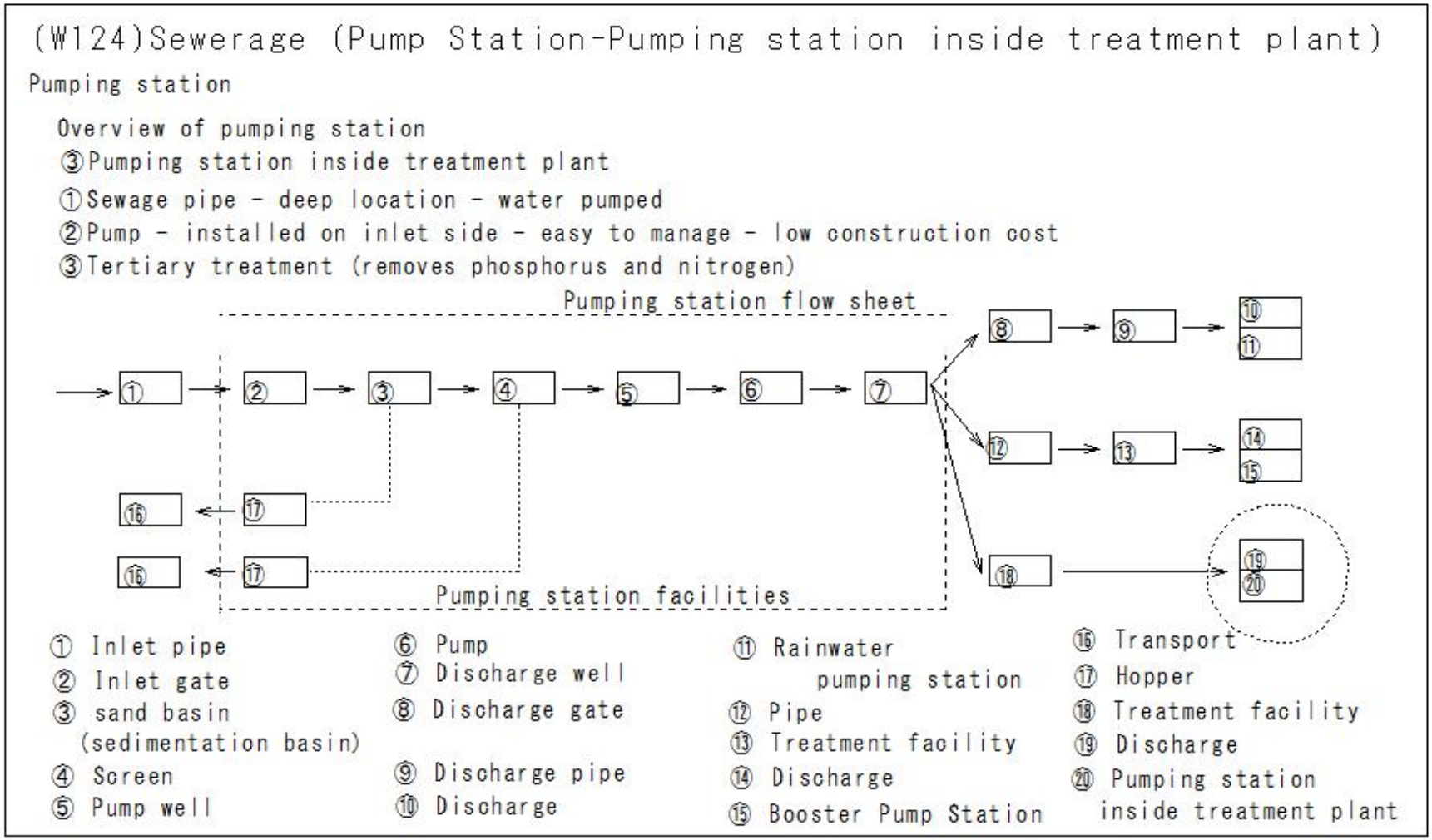
・Drilling depth - shallow Safety assurance Maintenance - easy

Pumping station flow sheet



① Inlet pipe
② Inlet gate
③ sand basin (sedimentation basin)
④ Screen
⑤ Pump well
⑥ Pump
⑦ Discharge well
⑧ Discharge gate
⑨ Discharge pipe
⑩ Discharge
⑪ Rainwater pumping station
⑫ Pipe
⑬ Treatment facility
⑭ Discharge
⑮ Booster Pump Station
⑯ Transport
⑰ Hopper
⑱ Treatment facility
⑲ Discharge
⑳ Pumping station inside treatment plant

(W124)Sewerage (Pump Station-Pumping station inside treatment plant)



(W125)Sewerage (Final treatment plant)

(W125)Sewerage (Final treatment plant)

Final treatment plant

The role of Final treatment plant

・Water treatment and sludge treatment

・Separating wastewater into water and pollutants → Water treatment

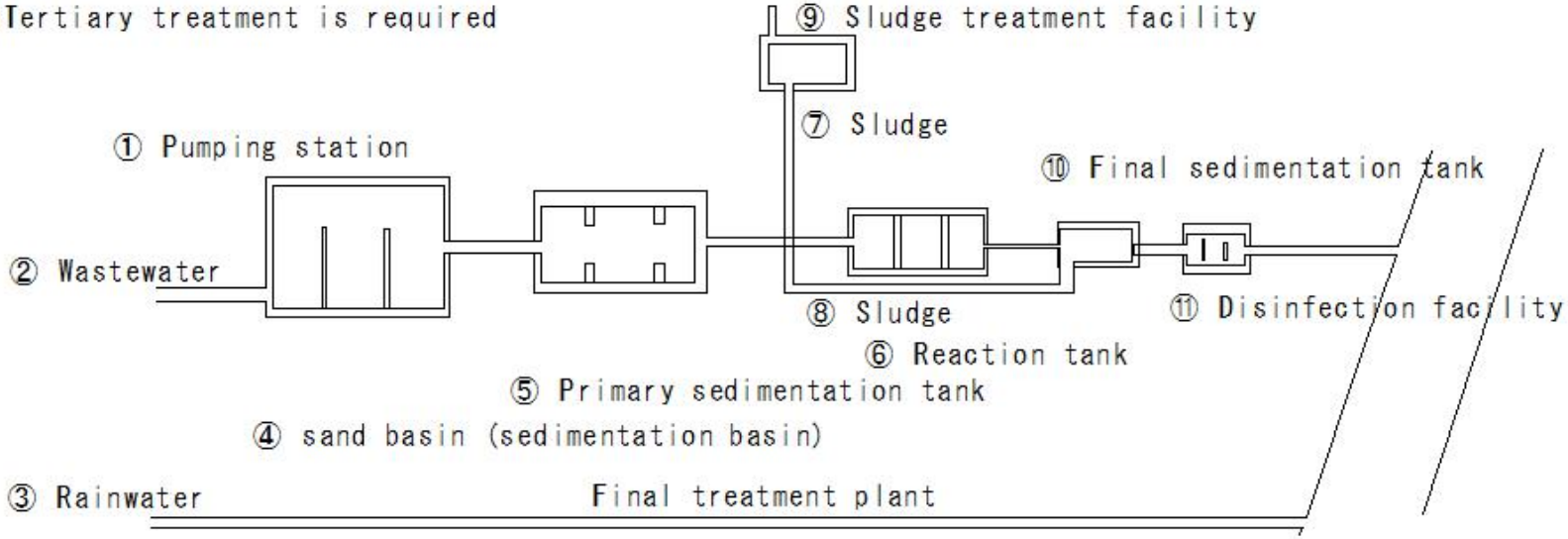
・Making the separated pollutants harmless → Sludge treatment

・Water treatment → Activated sludge method

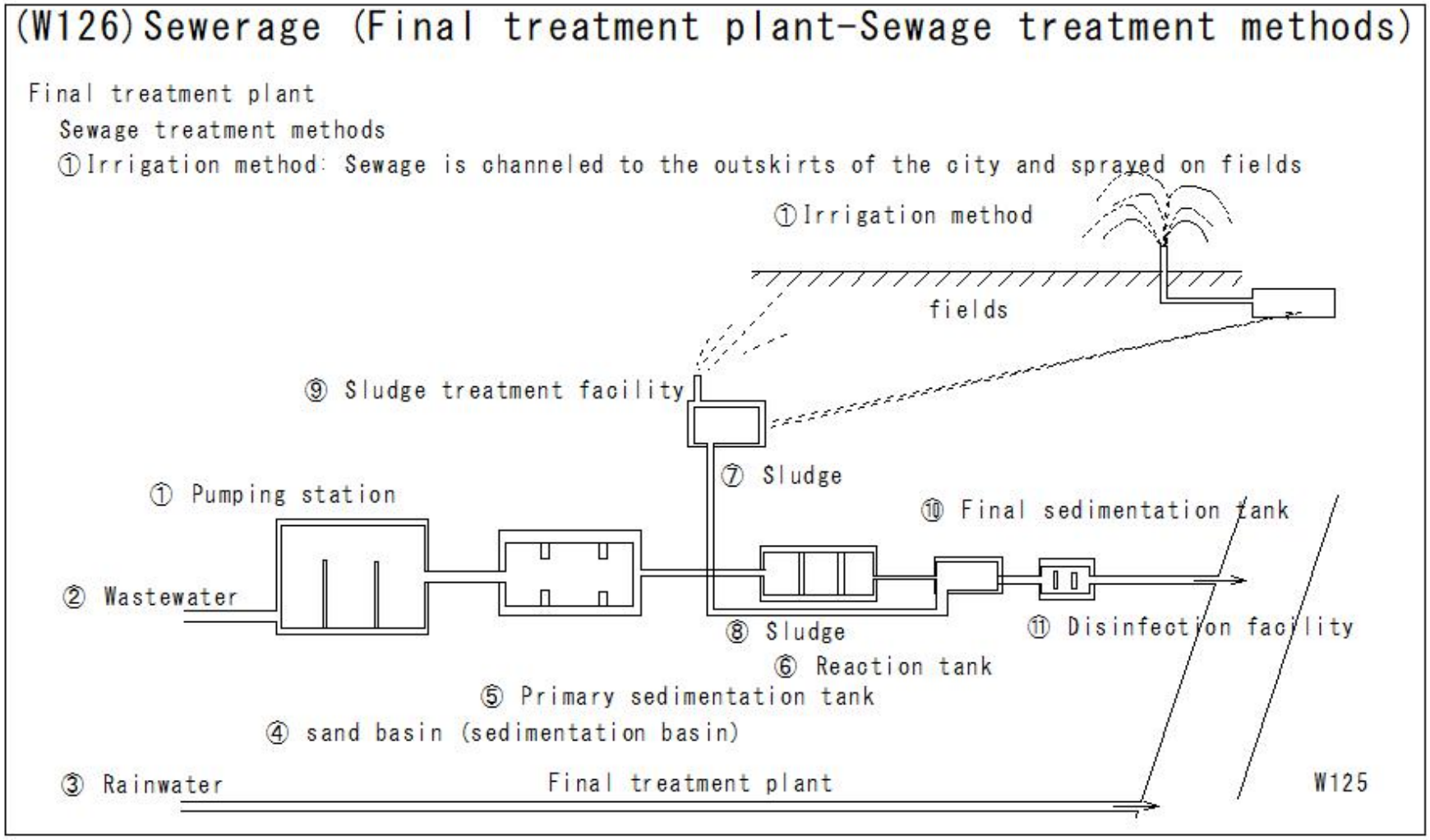
Phosphorus and nitrogen cannot be removed from the water

→Flows into the sea and lakes → Abnormal plankton outbreak (red tide)

→Tertiary treatment is required



(W126)Sewerage (Final treatment plant-Sewage treatment methods)



(W127)Sewerage (Sewage treatment methods-plain precipitation（Ordinary precipitation）)

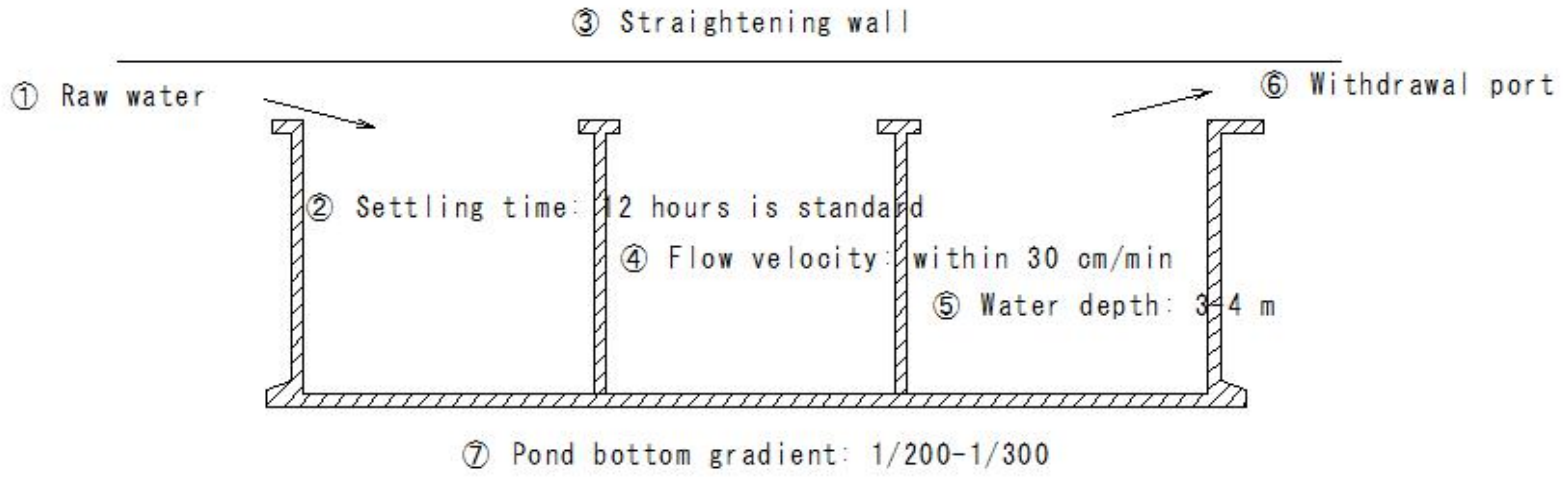
(W127)Sewerage (Sewage treatment methods-plain precipitation)

Final treatment plant

How to dispose of sewage

②plain precipitation: Reduces the flow velocity and naturally sinks the substance

Water quality standards have become stricter and are no longer adopted.



plain precipitation (Normal sedimentation)

W184

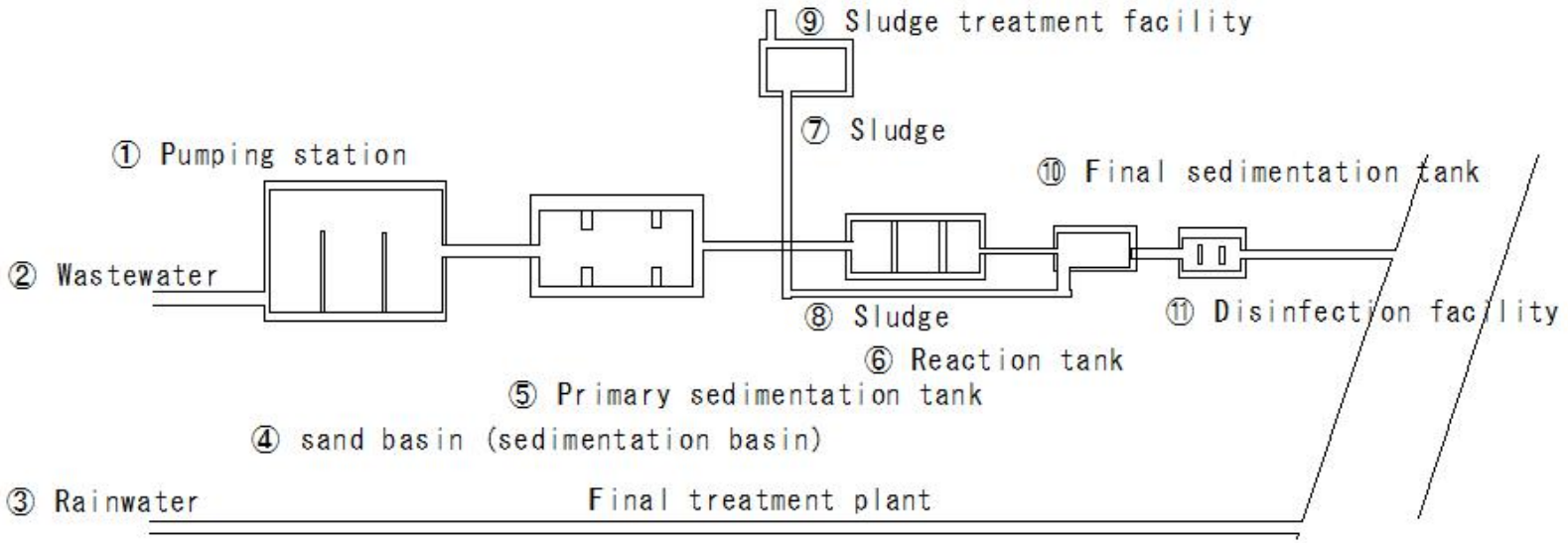
(W128)Sewerage (Sewage treatment methods- Septic tank)

(W128)Sewerage (Sewage treatment methods- Septic tank)

Final treatment plant

Sewage treatment methods

③Septic tank: Sludge at the bottom of the sedimentation tank (settling tank) is naturally decomposed by anaerobic bacteria and separated into gas and liquid



W125

(W129)Sewerage (Sewage treatment methods- Two-floor tank)

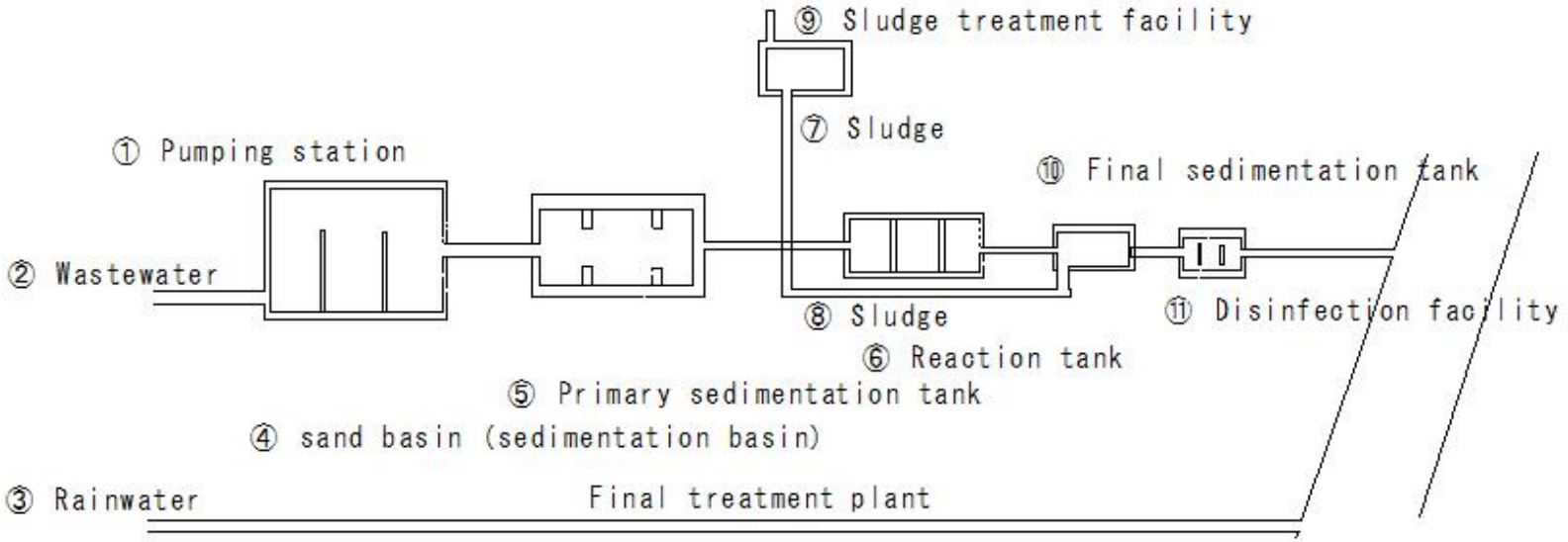
(W129)Sewerage (Sewage treatment methods- Two-floor tank)

Final treatment plant

How to dispose of sewage

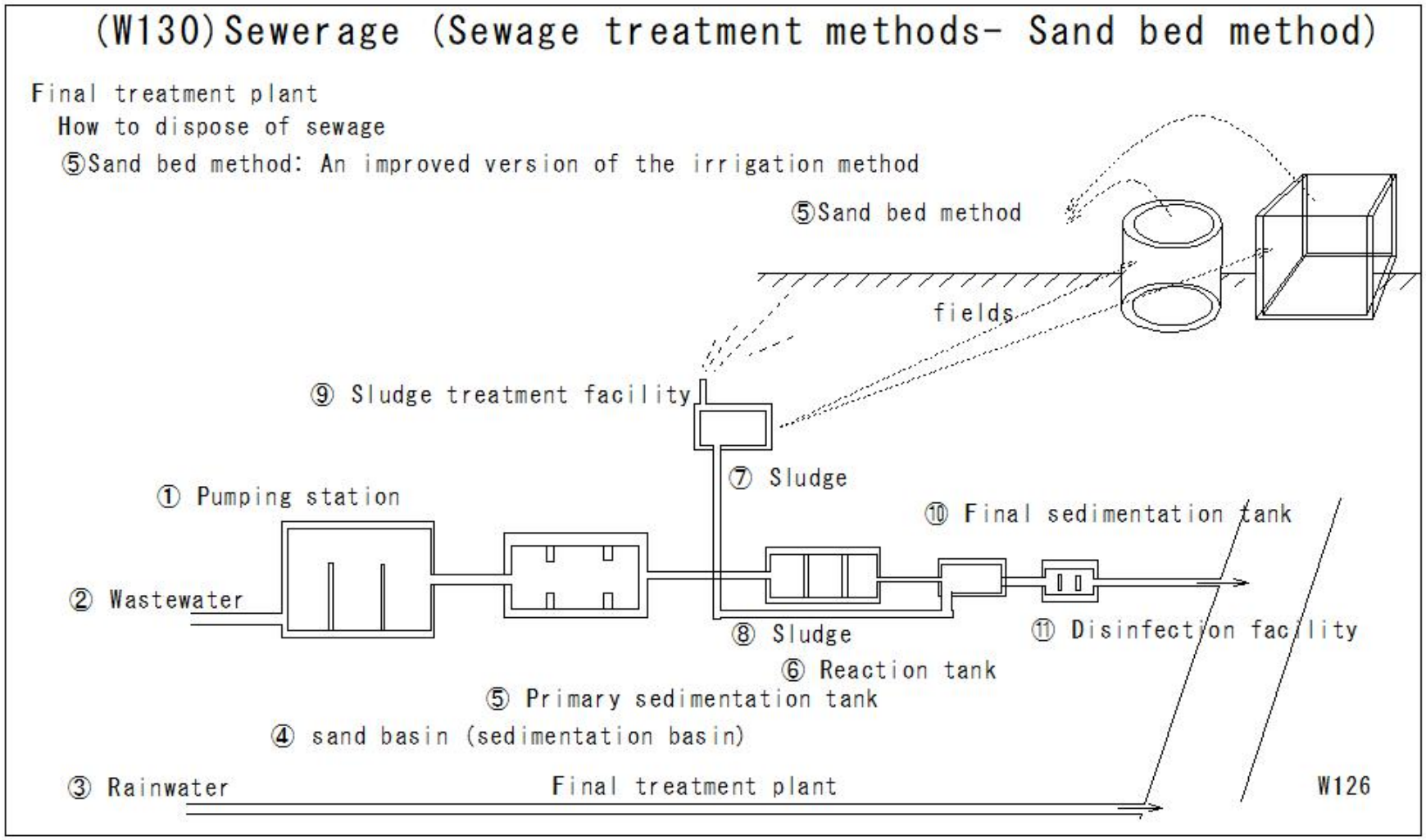
④Two-floor tank: Improved version of the decay tank

The top is the sedimentation pond, and the bottom is the structure of the sludge decay chamber.

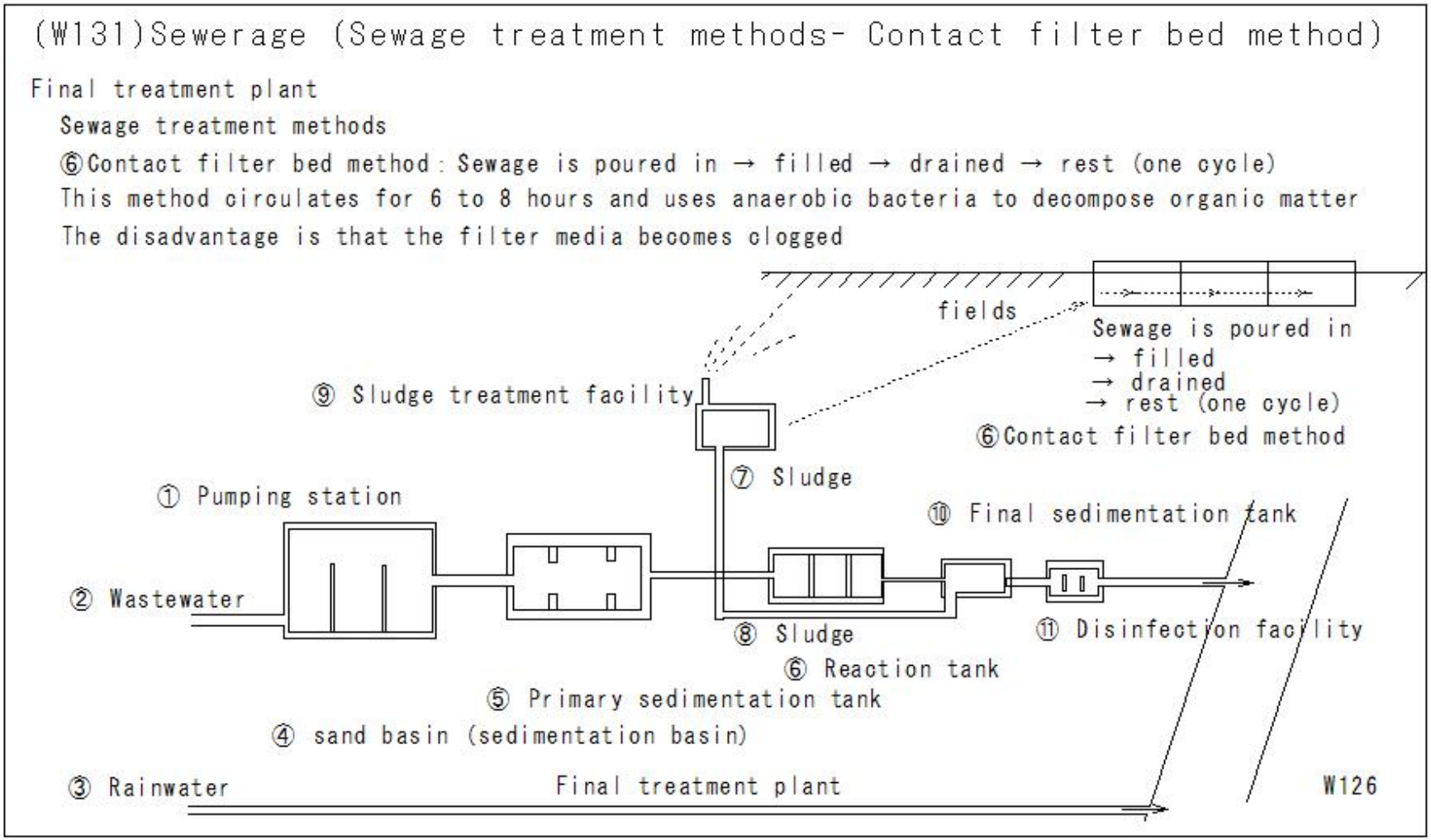


W128

(W130)Sewerage (Sewage treatment methods- Sand bed method)



(W131)Sewerage (Sewage treatment methods- Contact filter bed method)



(W132)Sewerage (Sewage treatment methods-Chemical precipitation)

(W132) Sewerage (Sewage treatment methods-Chemical precipitation)

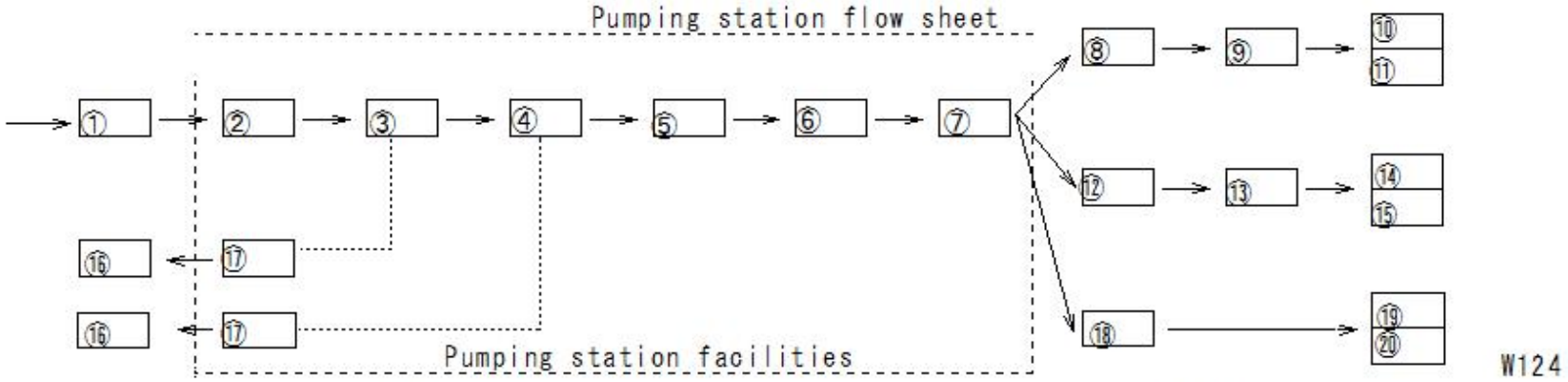
Final treatment plant

How to dispose of sewage

Method II.

①Chemical precipitation: Aggregated by precipitation of lime and other chemicals

Forced precipitation down to fine particles



W124

① Inlet pipe
② Inlet gate
③ sand basin (sedimentation basin)
④ Screen
⑤ Pump well
⑥ Pump
⑦ Discharge well
⑧ Discharge gate
⑨ Discharge pipe
⑩ Discharge
⑪ Rainwater pumping station
⑫ Pipe
⑬ Treatment facility
⑭ Discharge
⑮ Booster Pump Station
⑯ Transport
⑰ Hopper
⑱ Treatment facility
⑲ Discharge
⑳ Pumping station inside treatment plant

(W133)Sewerage (Sewage treatment methods-Sprinkling filter bed method)

(W133)Sewerage (Sewage treatment methods-Sprinkling filter bed method)

Final treatment plant

How to dispose of sewage

Method II.

②trickling filtration bed system (Sprinkling filter bed method)

・Improved type of contact filtration bed method

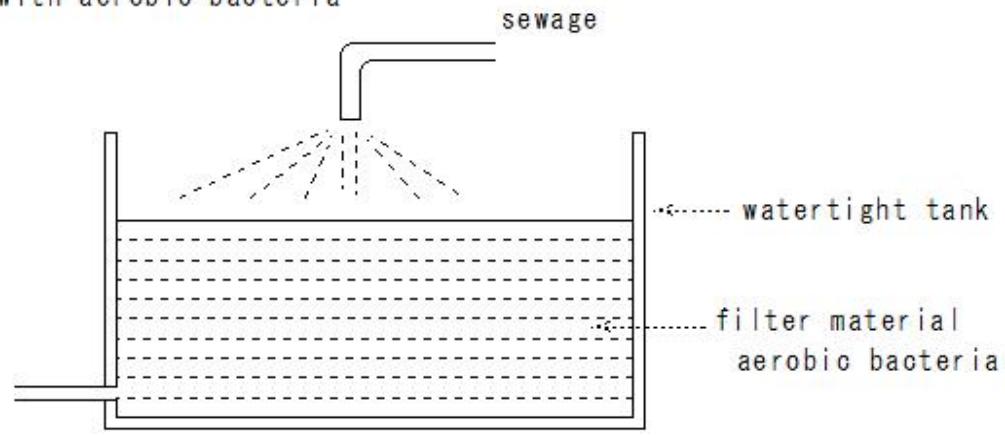
filter material packed in a watertight tank

Spraying sewage from above

How to treat organic matter in sewage with aerobic bacteria

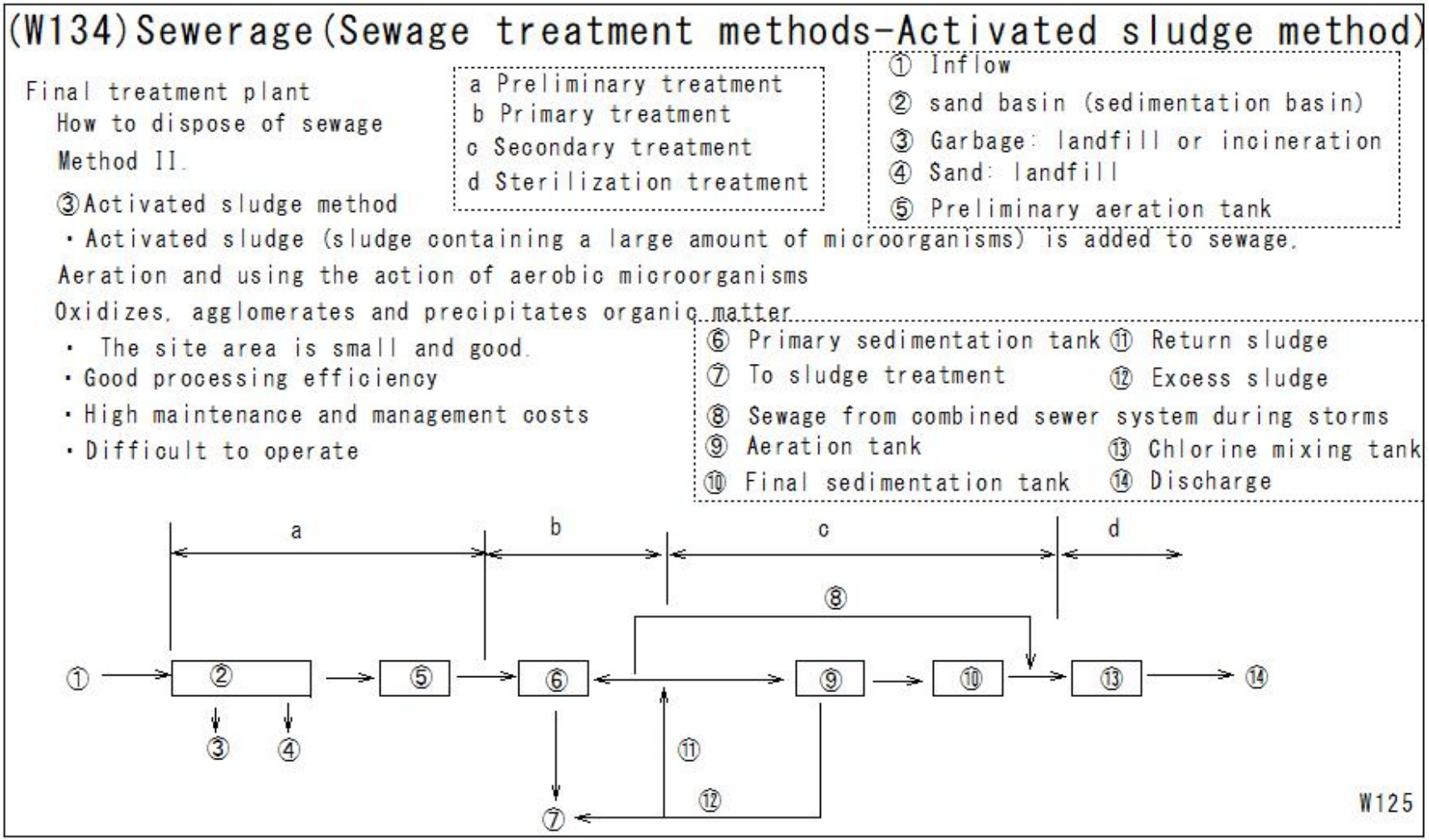
Advantage(process continuously)

Medium-sized treatment plants



②trickling filtration bed system (Sprinkling filter bed method)

(W134)Sewerage (Sewage treatment methods-Activated sludge method)



(W135)Sewerage (Sewage treatment methods-Activated sludge method)

(W135)Sewerage(Sewage treatment methods-Activated sludge method)

Final treatment plant

How to dispose of sewage

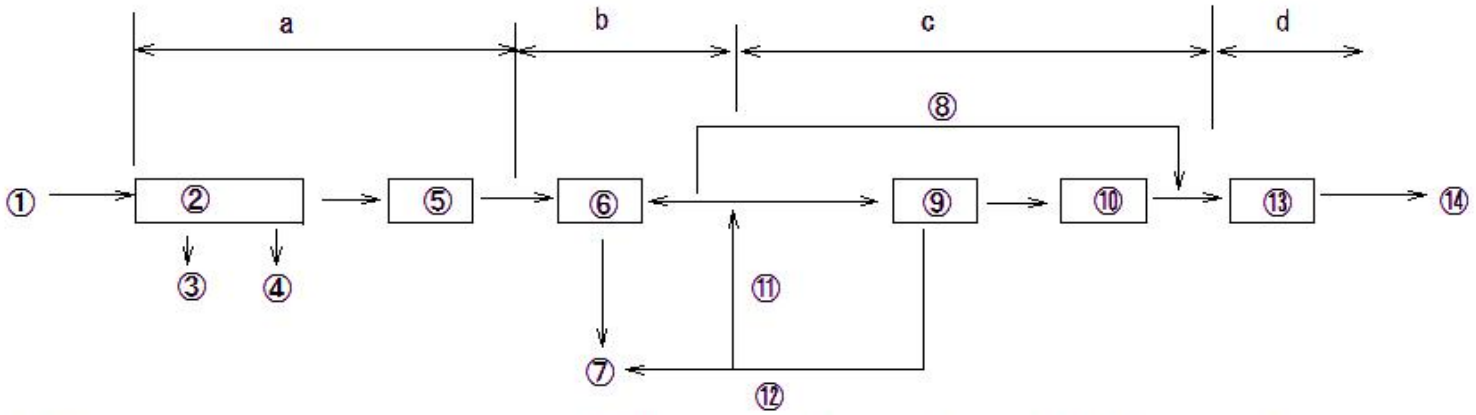
Method II.

③Activated sludge method

Treatment process

Flow sheet of the activated sludge method

a Preliminary treatment
b Primary treatment
c Secondary treatment
d Sterilization treatment



① Inflow
② sand basin (sedimentation basin)
③ Garbage: landfill or incineration
④ Sand: landfill
⑤ Preliminary aeration tank
⑥ Primary sedimentation tank
⑦ To sludge treatment
⑧ Sewage from combined sewer system during storms
⑨ Aeration tank
⑩ Final sedimentation tank
⑪ Return sludge
⑫ Excess sludge
⑬ Chlorine mixing tank
⑭ Discharge

(W136)Sewerage (Sewage treatment methods-Activated sludge method)

(W136)Sewerage(Sewage treatment methods-Activated sludge method)

Final treatment plant

How to dispose of sewage

Method II.

③Activated sludge method

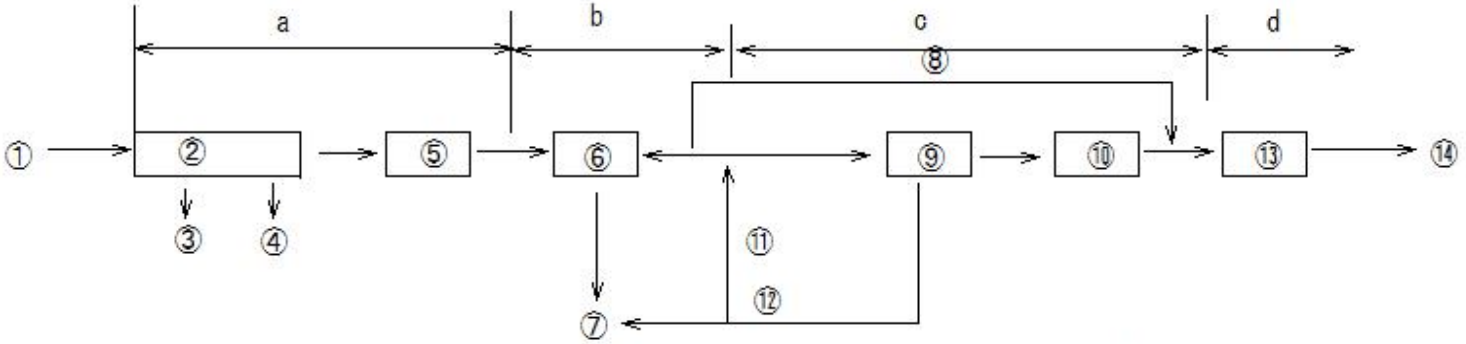
a Preliminary treatment

Remove sand from the sewage

Remove large debris with a screen

Aerate the sewage to prevent it from rotting

a Preliminary treatment
b Primary treatment
c Secondary treatment
d Sterilization treatment



① Inflow
② sand basin (sedimentation basin)
③ Garbage: landfill or incineration
④ Sand: landfill
⑤ Preliminary aeration tank
⑥ Primary sedimentation tank
⑦ To sludge treatment
⑧ Sewage from combined sewer system during storms
⑨ Aeration tank
⑩ Final sedimentation tank
⑪ Return sludge
⑫ Excess sludge
⑬ Chlorine mixing tank
⑭ Discharge

(W137)Sewerage (Sewage treatment methods-Activated sludge method)

(W137)Sewerage(Sewage treatment methods-Activated sludge method)

Final treatment plant

How to dispose of sewage

Method II.

③Activated sludge method

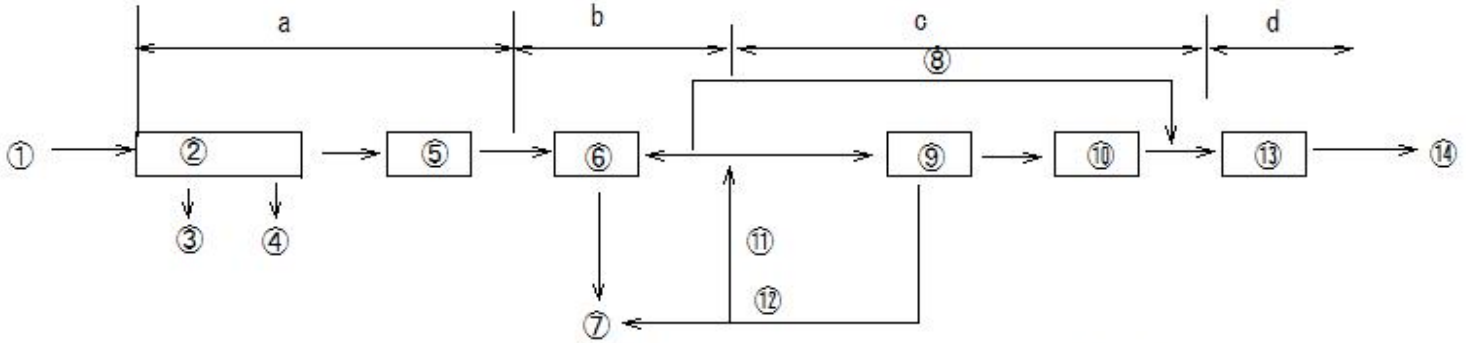
b Primary treatment (sedimentation treatment)

Remove settled solids

Sediment is treated as sludge

Combined system is discharged

a Preliminary treatment
b Primary treatment
c Secondary treatment
d Sterilization treatment



① Inflow
② sand basin (sedimentation basin)
③ Garbage: landfill or incineration
④ Sand: landfill
⑤ Preliminary aeration tank
⑥ Primary sedimentation tank
⑦ To sludge treatment
⑧ Sewage from combined sewer system during storms
⑨ Aeration tank
⑩ Final sedimentation tank
⑪ Return sludge
⑫ Excess sludge
⑬ Chlorine mixing tank
⑭ Discharge

(W138)Sewerage (Sewage treatment methods-Activated sludge method)

(W138)Sewerage(Sewage treatment methods-Activated sludge method)

Final treatment plant

How to dispose of sewage

Method II.

③Activated sludge method

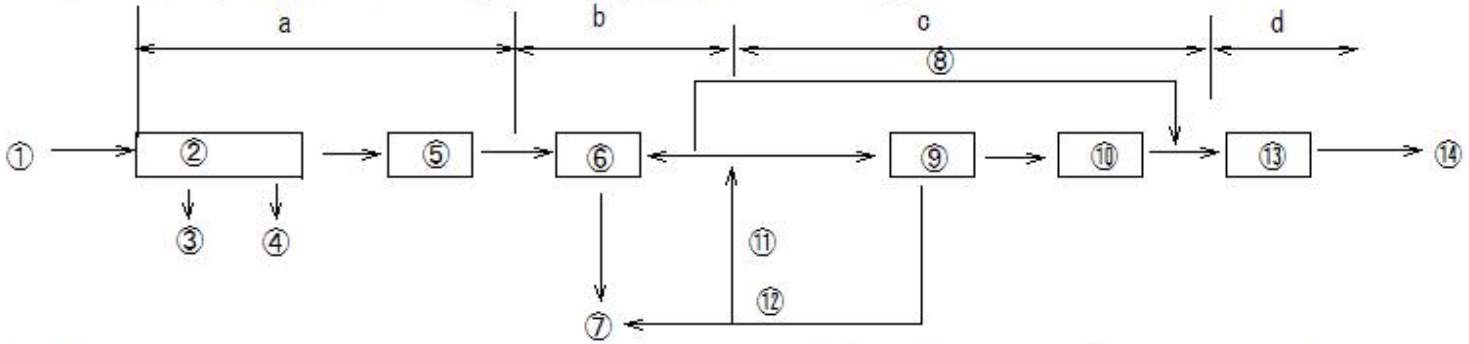
a Preliminary treatment
b Primary treatment
c Secondary treatment
d Sterilization treatment

c. Secondary treatment (biological treatment)

・Mixed activated sludge and air into the primary treated water with an air tank.

・The material that has settled in the air tank is used for activated sludge and sewage treatment.

The remaining activated sludge is disposed of as sludge.



① Inflow
② sand basin (sedimentation basin)
③ Garbage: landfill or incineration
④ Sand: landfill
⑤ Preliminary aeration tank
⑥ Primary sedimentation tank
⑦ To sludge treatment
⑧ Sewage from combined sewer system during storms
⑨ Aeration tank
⑩ Final sedimentation tank
⑪ Return sludge
⑫ Excess sludge
⑬ Chlorine mixing tank
⑭ Discharge

(W139)Sewerage (Sewage treatment methods-Activated sludge method)

(W139)Sewerage(Sewage treatment methods-Activated sludge method)

Final treatment plant

How to dispose of sewage

Method II.

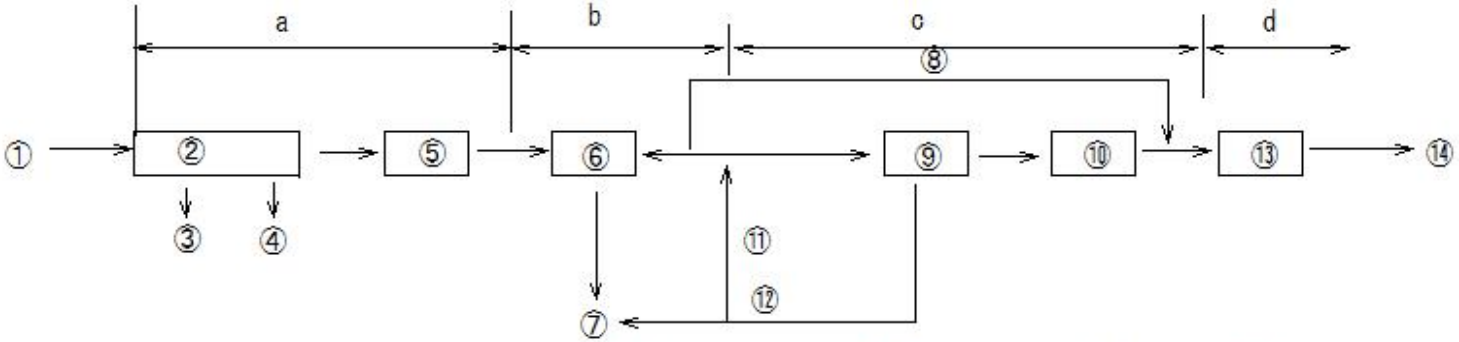
③Activated sludge method

d Sterilization treatment

・Chlorine gas is injected.

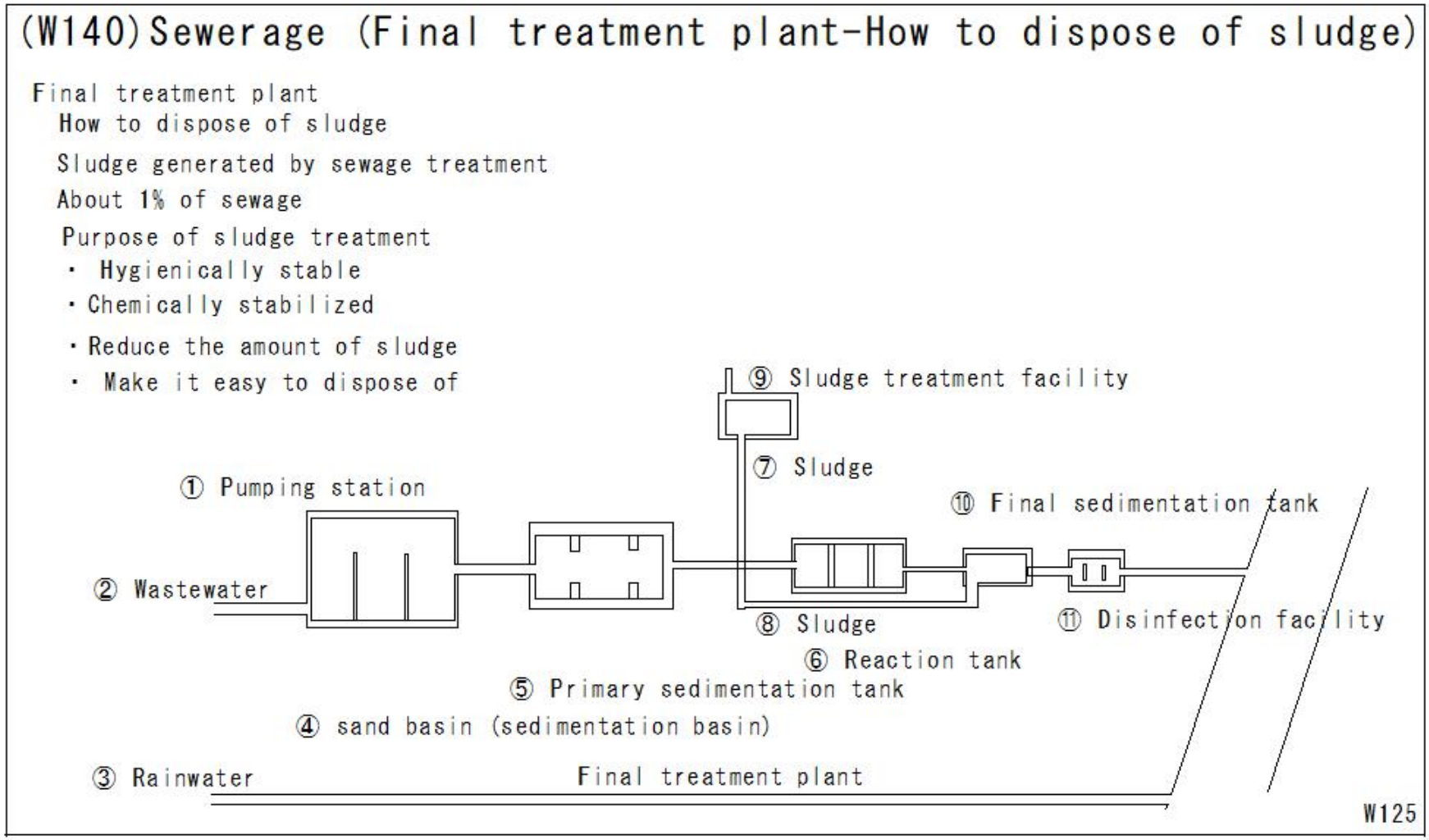
・Sterilization effect is determined by the number of colon groups.

a Preliminary treatment
b Primary treatment
c Secondary treatment
d Sterilization treatment

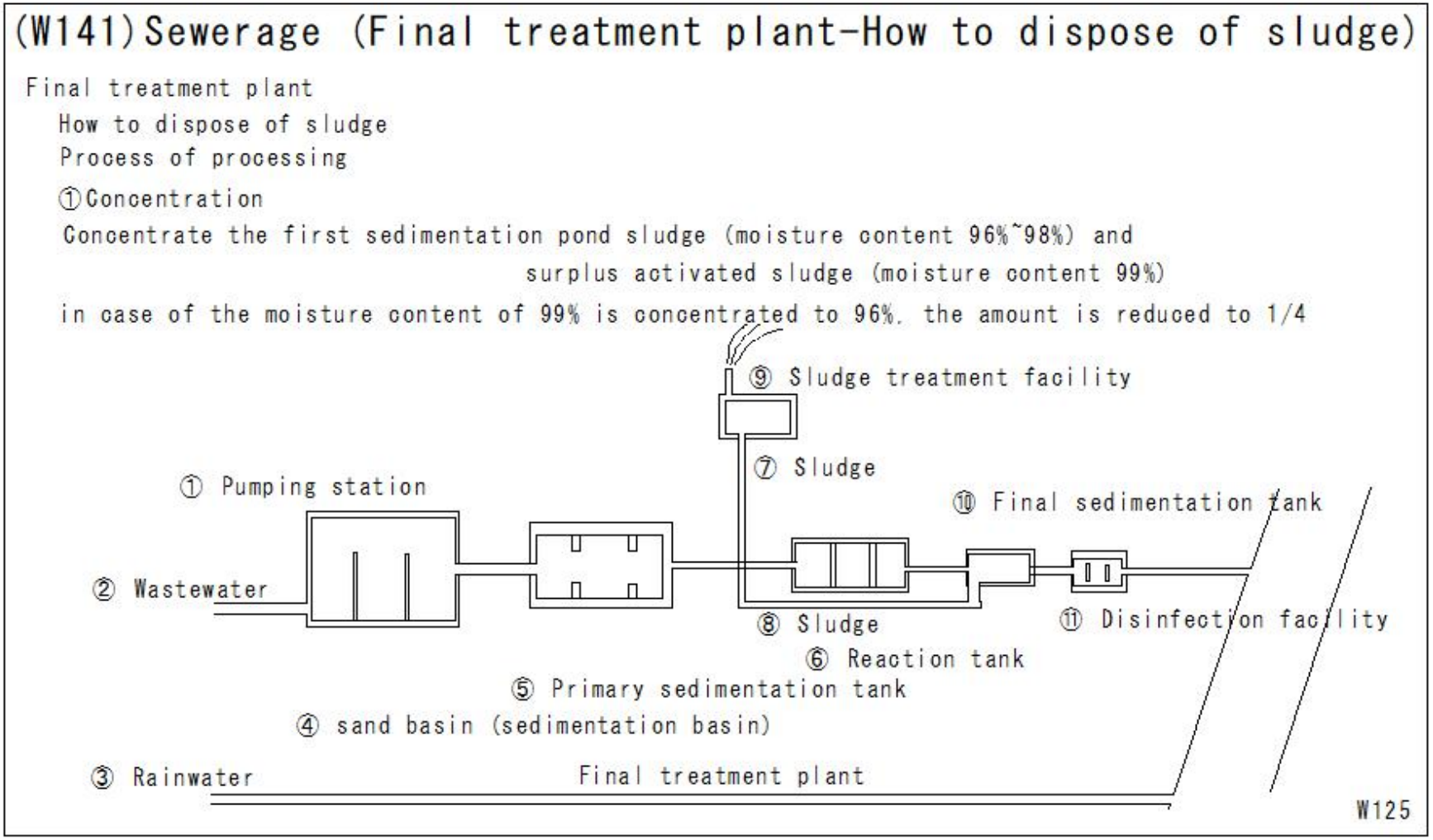


① Inflow
② sand basin (sedimentation basin)
③ Garbage: landfill or incineration
④ Sand: landfill
⑤ Preliminary aeration tank
⑥ Primary sedimentation tank
⑦ To sludge treatment
⑧ Sewage from combined sewer system during storms
⑨ Aeration tank
⑩ Final sedimentation tank
⑪ Return sludge
⑫ Excess sludge
⑬ Chlorine mixing tank
⑭ Discharge

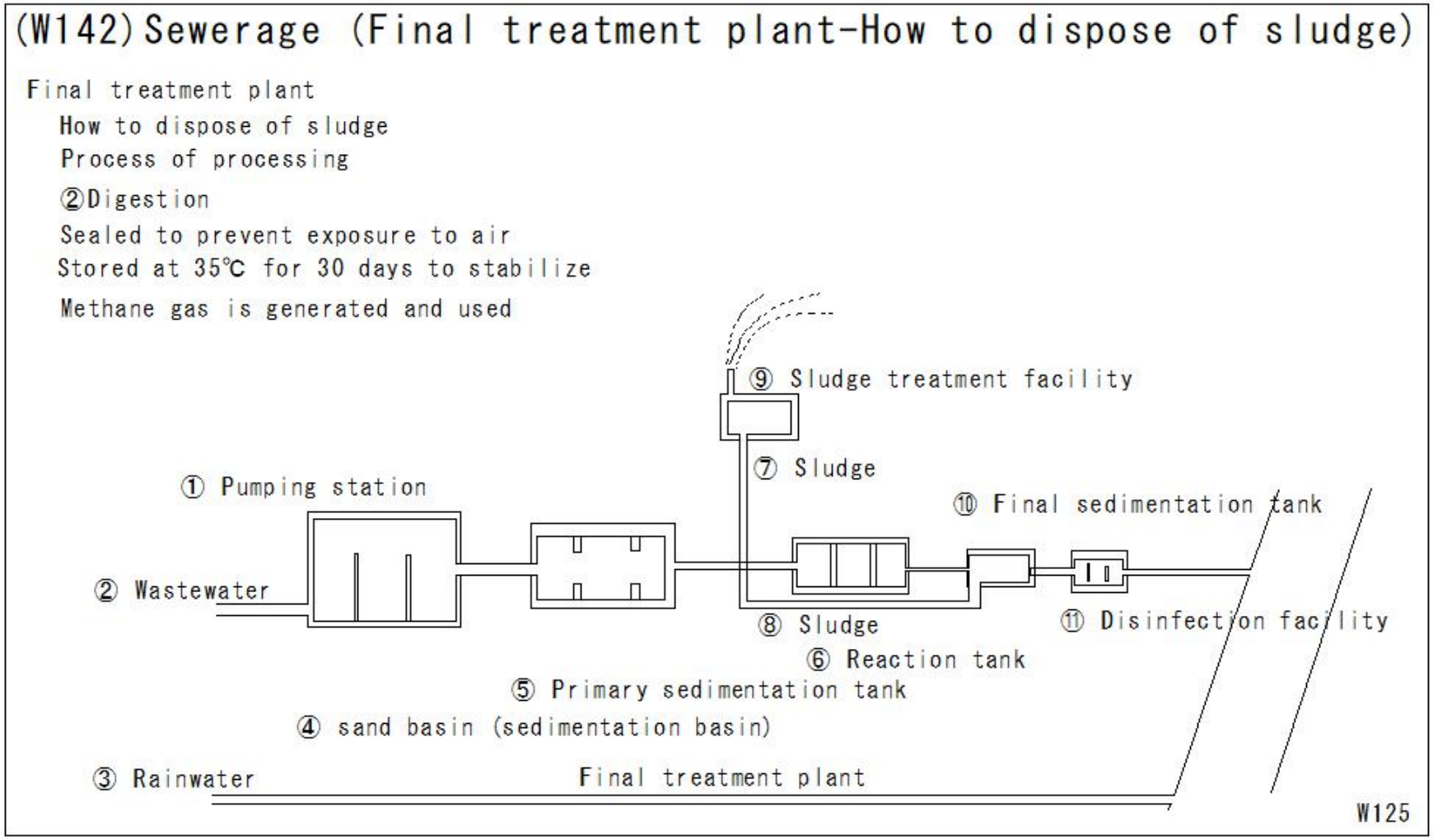
(W140)Sewerage (Final treatment plant-How to dispose of sludge)



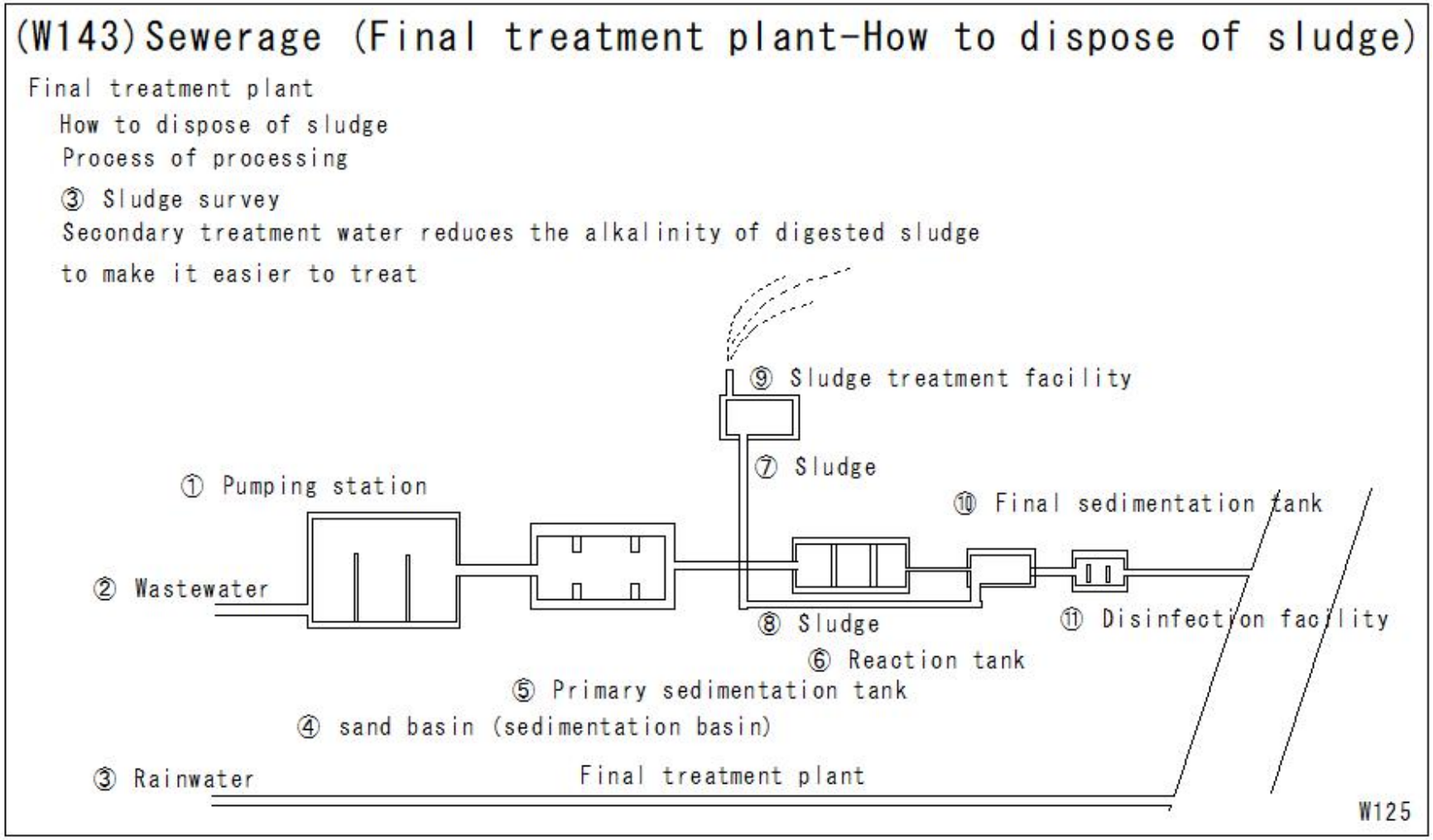
(W141)Sewerage (Final treatment plant-How to dispose of sludge)



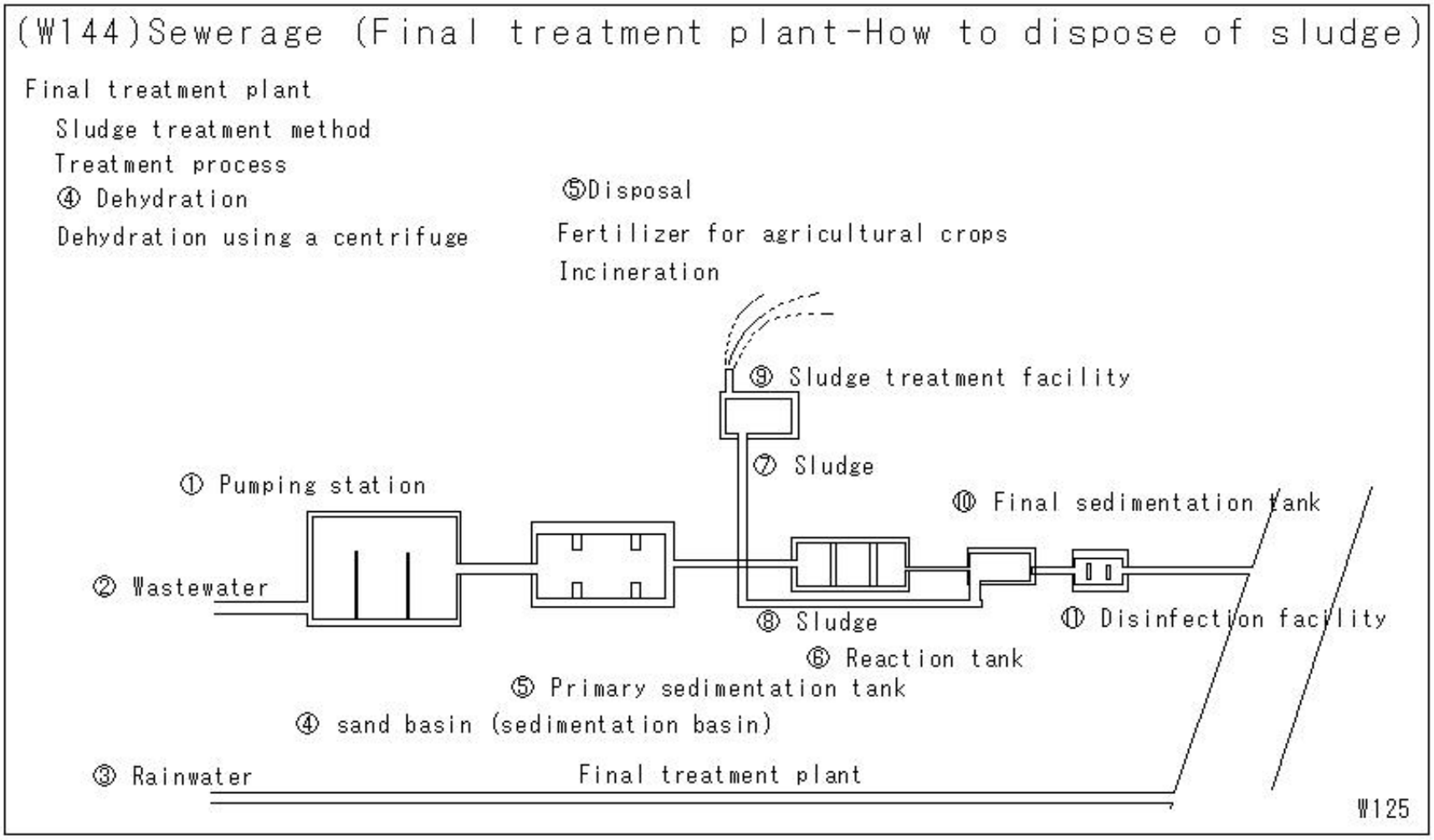
(W142)Sewerage (Final treatment plant-How to dispose of sludge)



(W143)Sewerage (Final treatment plant-How to dispose of sludge)



(W144)Sewerage (Final treatment plant-How to dispose of sludge)



(W145)Water supply

(W145)Water supply

Water supply

Water supply structure

① Water intake (water source, screen) →

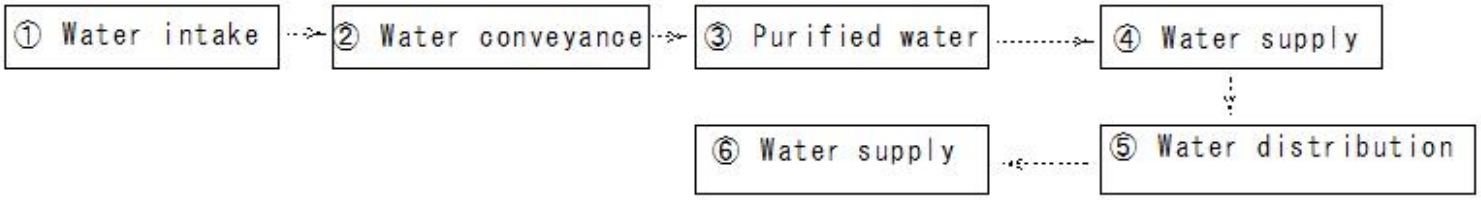
② Water conveyance (sand basin, water conveyance pump, water conveyance pipe) →

③ Purified water (sand basin, filtration basin, chlorine disinfection, purified water basin: advanced water purification treatment) →

④ Water supply (water supply pump, water supply pipe) →

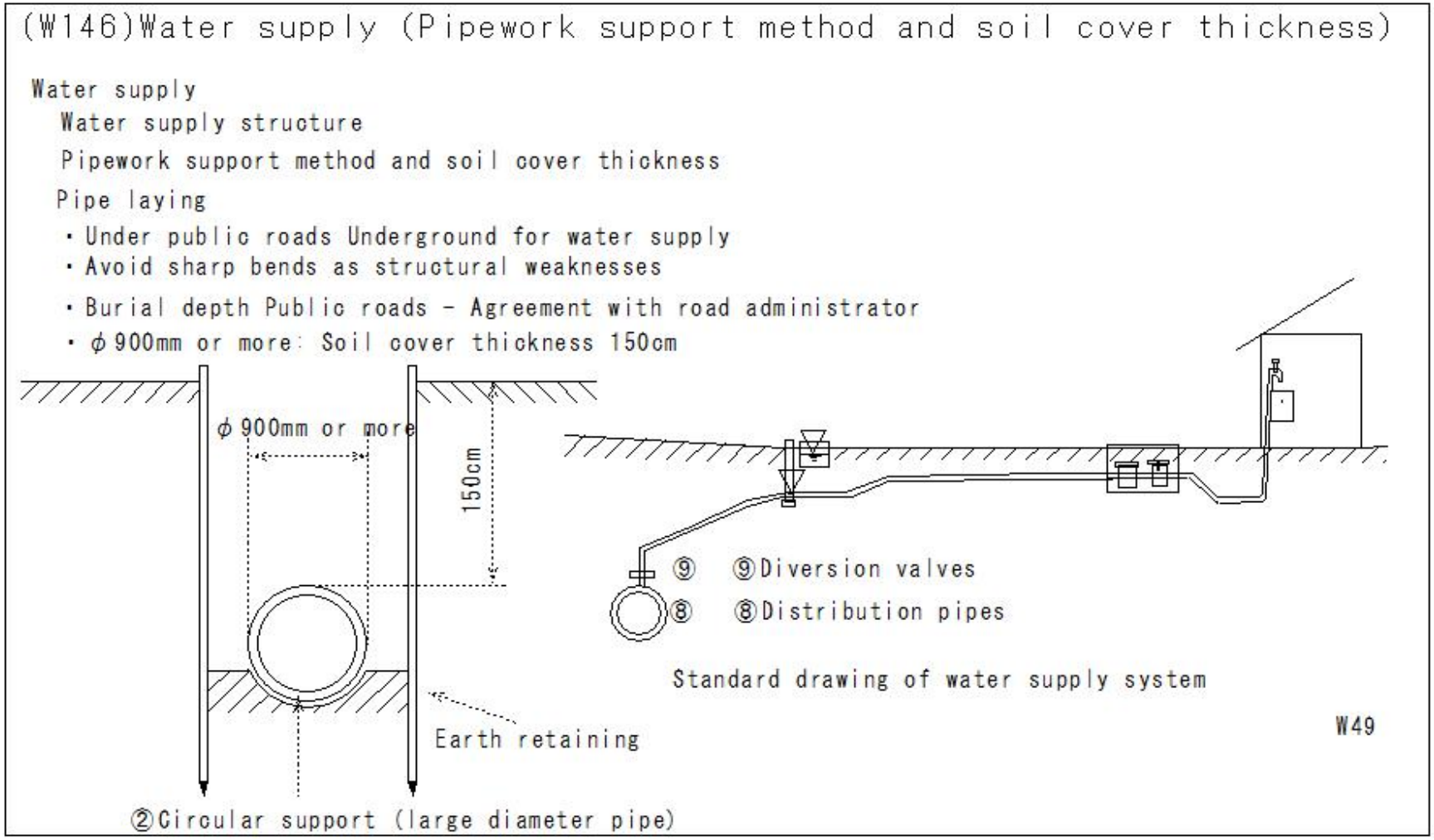
⑤ Water distribution (water distribution tower, drainage pipe) →

⑥ Water supply (water distribution valve, water stop valve, water supply pipe, water meter, water supply valve)

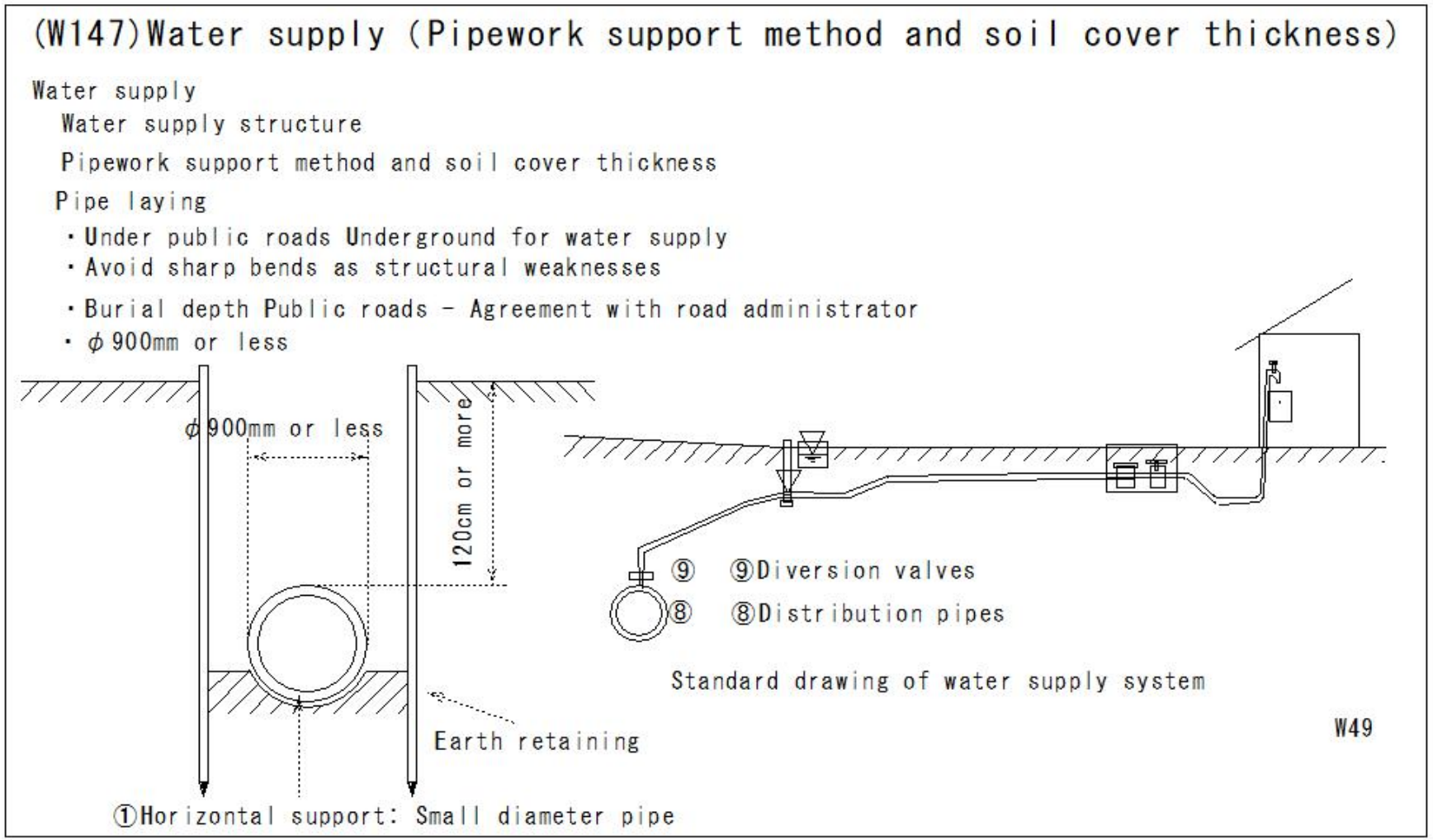


Water supply structure

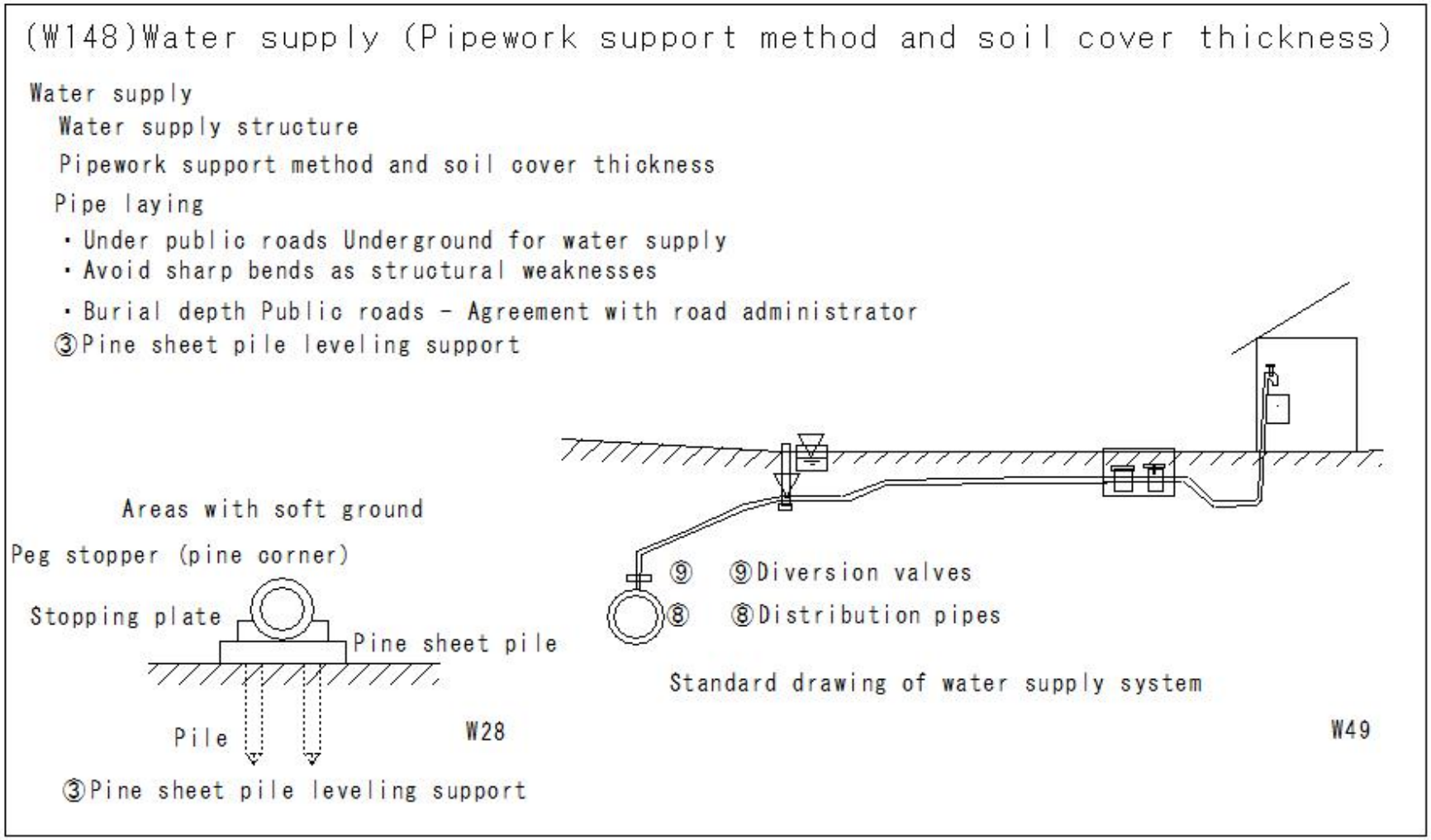
(W146)Water supply（Pipework support method and soil cover thickness）



(W147)Water supply（Pipework support method and soil cover thickness）



(W148)Water supply（Pipework support method and soil cover thickness）



(W149)Water supply（Types and characteristics of pipes）

(W149)Water supply (Types and characteristics of pipes)

Water supply

Water supply structure

Types and characteristics of pipes

①Cast iron pipe

Strength - high

Corrosion resistance - high

Long-term use - rust occurs

②Ductile cast iron pipe

Strength - high

Corrosion resistance - high

Toughness - high

③Copper pipe

Lightweight

Tensile strength/flexibility - high

Welding - possible

Corrosivity - high

④Prestressed concrete pipe

Corrosion resistance - high

Price - low

Roughness of inner surface - does not change

Heavy weight - difficult to install

Irregular pipe - none

⑤Asbestos cement pipe for water supply

Corrosion resistance - high

Irregular pipe - none

Electrical corrosion - none

Roughness of inner surface - does not change

Shear force - weak

⑥Rigid polyvinyl chloride pipe for water supply

Corrosion resistance - high

Price - low

Electrical corrosion - none

Roughness of inner surface - does not change

Impact, heat, ultraviolet rays - weak

(W150)Water supply（Types and characteristics of pipes）

(W150)Water supply (Types and characteristics of pipes)

Water supply

Water supply structure

Types and characteristics of pipes

①Cast iron pipe

Strength - high

Corrosion resistance - high

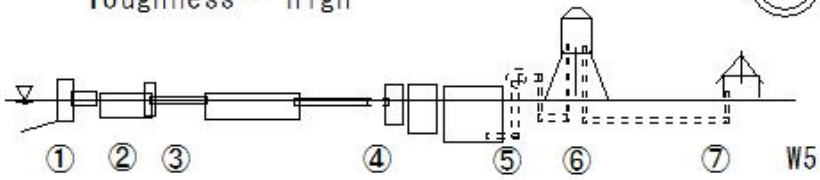
Long-term use - rust occurs

②Ductile cast iron pipe

Strength - high

Corrosion resistance - high

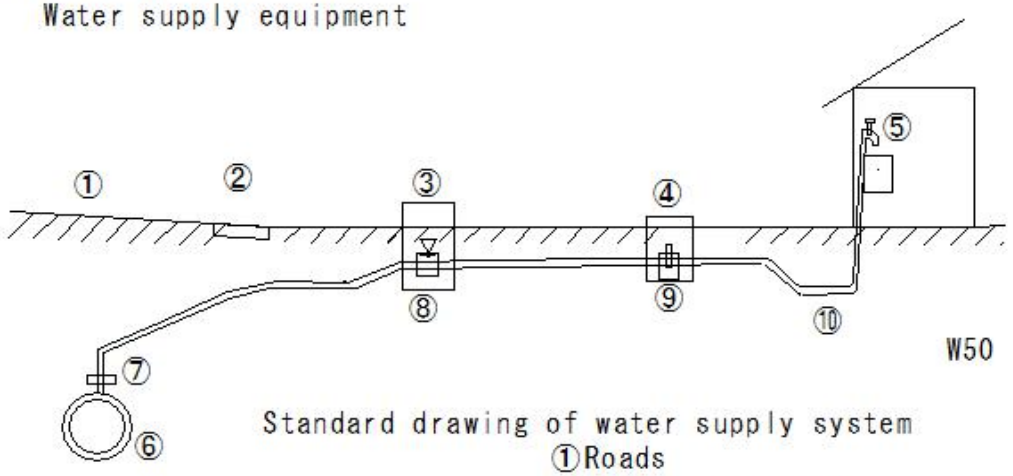
Toughness - high



① Water intake
② Water storage
③ Water conveyance
④ Water purification
⑤ Water supply
⑥ Water distribution
⑦ Water supply

Waterworks facilities

Water supply equipment



Standard drawing of water supply system

①Roads
②Private property
③Stop valves
④Meters
⑤Water supply valves
⑥Distribution pipes
⑦Diversion valves
⑧Stop valves
⑨Water meters
⑩Water supply pipes

(W151)Water supply（Types and characteristics of pipes）

(W151)Water supply (Types and characteristics of pipes)

Water supply

Water supply structure

Types and characteristics of pipes

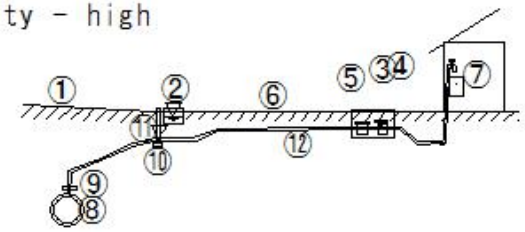
③Copper pipe

Lightweight

Tensile strength/flexibility - high

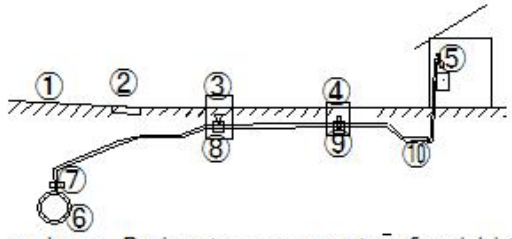
Welding - possible

Corrosivity - high



W49

Stop valves Road facilities



W50

Stop valves Private property facilities

Standard drawing of water supply system

①Roads
②Sewer pipes
③Stop valves
④Meters
⑤Water meters
⑥Private property
⑦Water supply valves
⑧Distribution pipes
⑨Diversion valves
⑩Stop valves
⑪Stop valves
⑫Water supply pipes

①Roads
②Private property
③Stop valves
④Meters
⑤Water supply valves
⑥Distribution pipes
⑦Diversion valves
⑧Stop valves
⑨Water meters
⑩Water supply pipes

W53

(W152)Water supply（Types and characteristics of pipes）

(W152)Water supply (Types and characteristics of pipes)

Water supply

Composition of water supply

Types and characteristics of pipes

④Prestressed concrete pipe

Corrosion resistance - high

Price - low

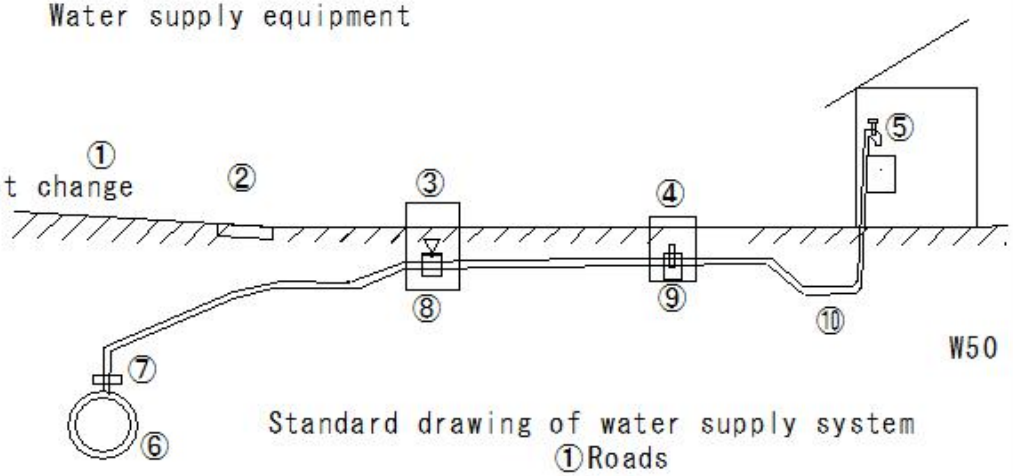
Roughness of inner surface - does not change

Heavy weight - difficult to install

Irregular pipe - none

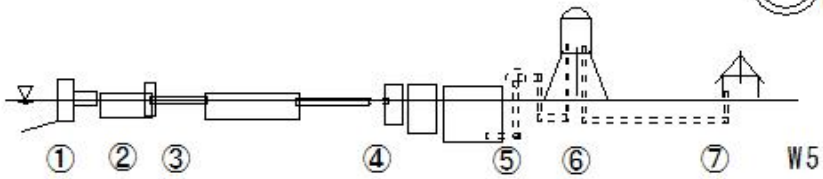
Waterworks facilities

Water supply equipment



Standard drawing of water supply system

①Roads
②Private property
③Stop valves
④Meters
⑤Water supply valves
⑥Distribution pipes
⑦Diversion valves
⑧Stop valves
⑨Water meters
⑩Water supply pipes



① Water intake
② Water storage
③ Water conveyance
④ Water purification
⑤ Water supply
⑥ Water distribution
⑦ Water supply

(W153)Water supply（Types and characteristics of pipes）

(W153)Water supply (Types and characteristics of pipes)

Water supply

Composition of water supply

Types and characteristics of pipes

⑤Asbestos cement pipe for water supply

Corrosion resistance - high

Irregular pipe - none

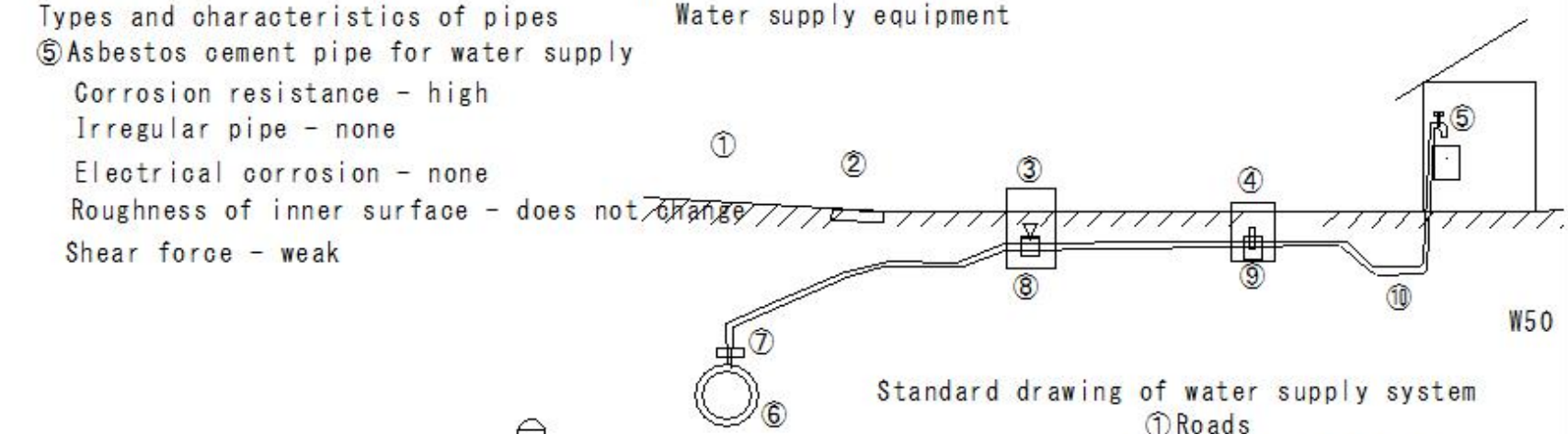
Electrical corrosion - none

Roughness of inner surface - does not change

Shear force - weak

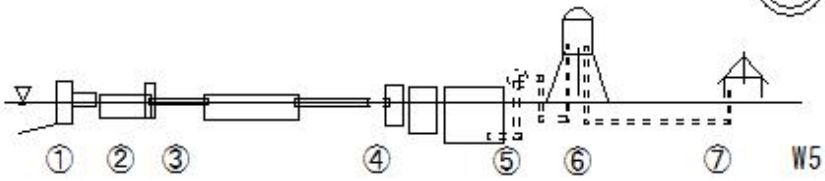
Waterworks facilities

Water supply equipment



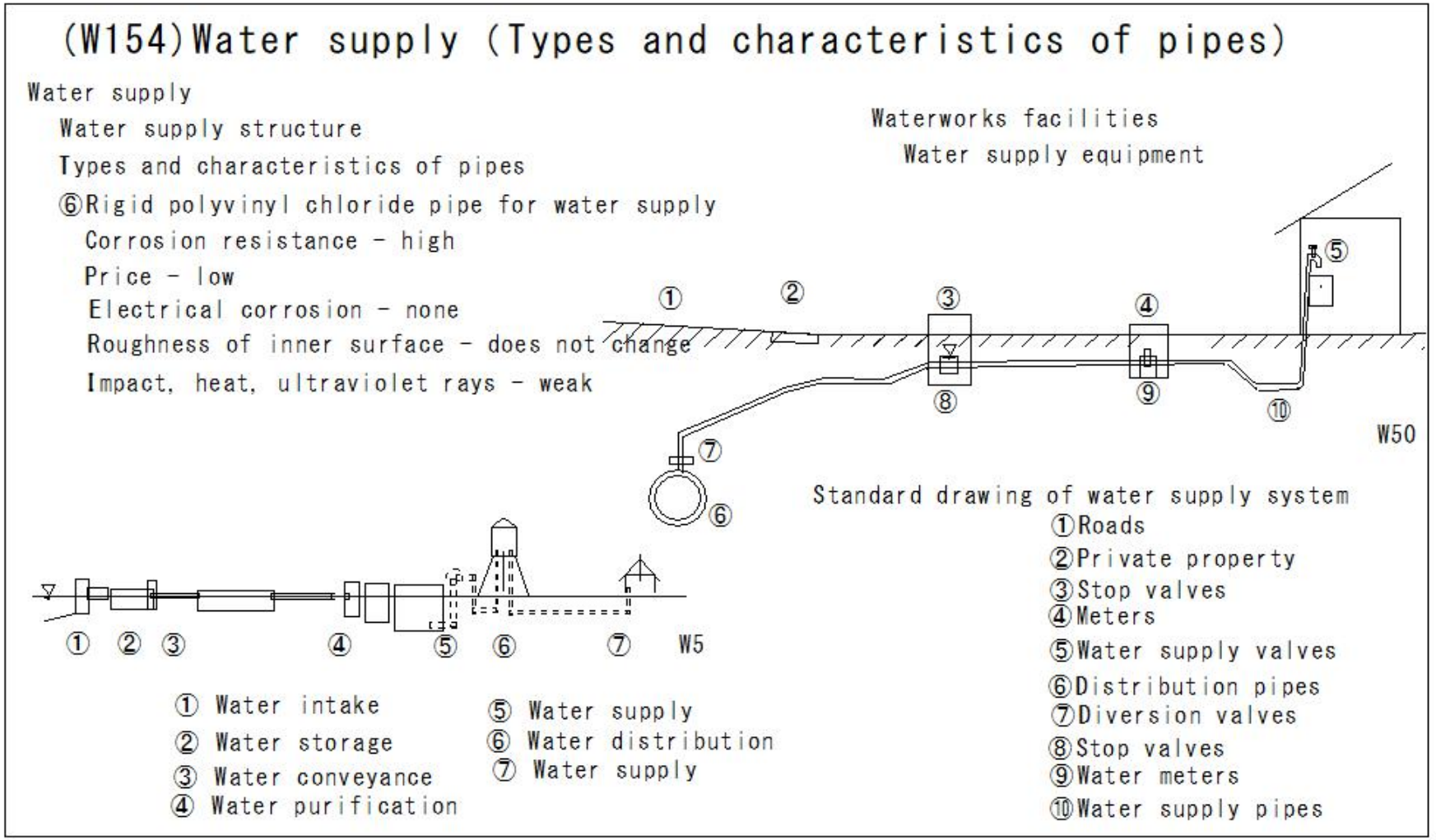
Standard drawing of water supply system

①Roads
②Private property
③Stop valves
④Meters
⑤Water supply valves
⑥Distribution pipes
⑦Diversion valves
⑧Stop valves
⑨Water meters
⑩Water supply pipes



① Water intake
② Water storage
③ Water conveyance
④ Water purification
⑤ Water supply
⑥ Water distribution
⑦ Water supply

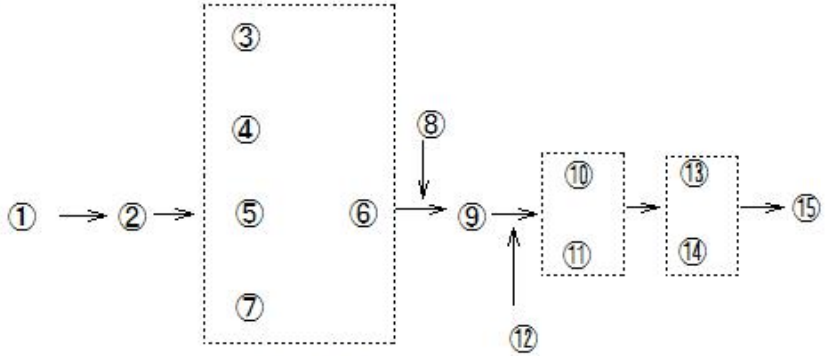
(W154)Water supply（Types and characteristics of pipes）



(W155)Water supply（Water purification(clean water) facility)

(W155)Water supply (Water purification(clean water) facility)

Water supply
Water purification(clean water)) facility
Rapid filtration method



Rapid filtration method

①Raw water
②Receiving well
③Chemical injection
④Mixing basin
⑤Flocculation basin(coagulation basin)
⑥Chemical sedimentation basin
⑦High-speed flocculation and sedimentation basin
⑧Middle ozone contact basin
⑨Rapid filtration basin(rapid sand filtration)
⑩Chlorine injection
⑪Chlorine injection well
⑫Post-ozone contact basin
⑬Purified water reservoir
⑭Distribution reservoir
⑮Water supply(water-conveyance)

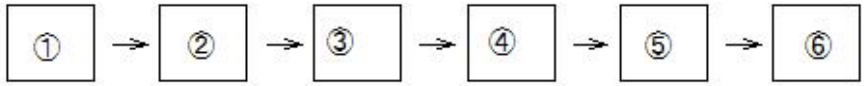
(W156)Sewerage

(W156)Sewerage

Sewerage

Sewerage system composition

Sewerage system flow



① Sewage

Domestic water, local water, rainwater

② Primary sedimentation tank

1-3 hours

③ Aeration tank

4-6 hours

④ Final sedimentation tank

2-2.5 hours

⑤ Chlorine mixing tank

15 minutes or more

⑥ Treated water

Discharged into rivers and oceans

W2

(W157)Sewerage(separate system・combined system)

(W157)Sewerage(separate system・combined system)

Sewerage

Sewerage structure

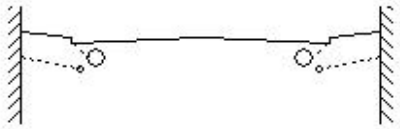
Sewerage systems and classification

Sewage: rain water and sewage

・Separate system: separate pipes

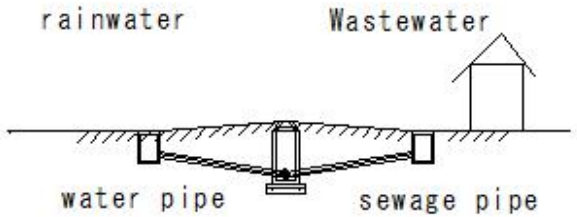
・Combined system: rain water and sewage run through the same pipe

separate system



W261

combined system



W236

○: Large circle: water pipe
◦: Small circle: sewage pipe

W68

(W158)Sewerage(Sewerage systems and classification）

(W158)Sewerage(Sewerage systems and classification)

Sewerage

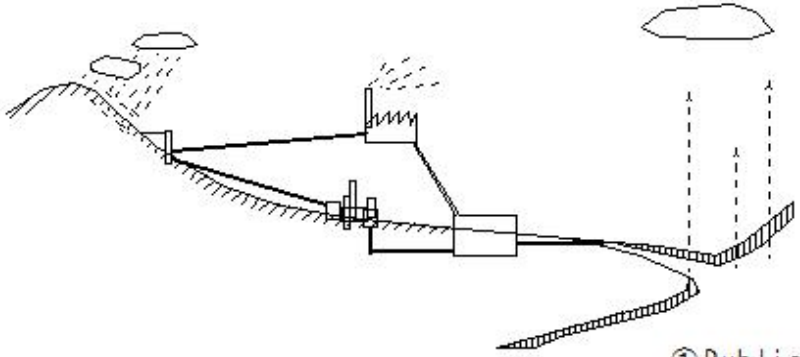
Sewerage structure

Sewerage systems and classification

①Public sewerage

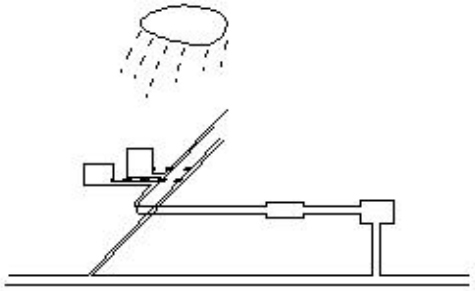
②River basin sewerage

③Urban sewerage



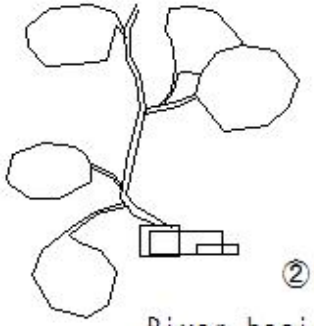
①Public sewerage

W57



W59

③Urban sewerage



②River basin sewerage

River basin sewerage treatment plant

W58

W59

(W159)Sewerage(Joining pipes-Water Surface joint)

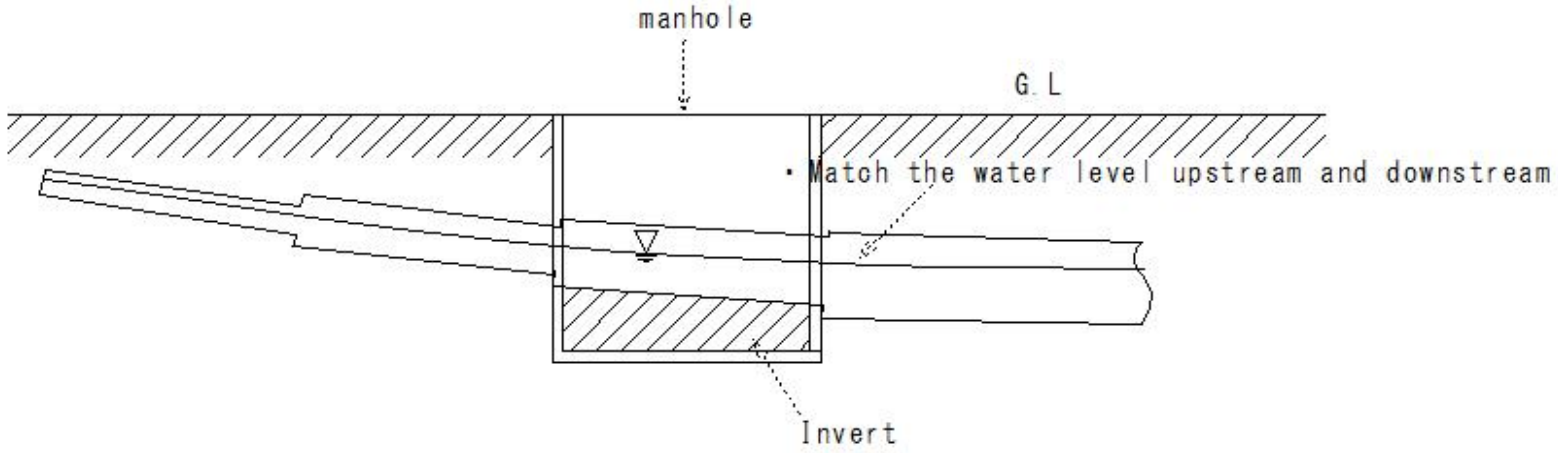
(W159)Sewerage(Joining pipes-Water Surface joint)

sewer

Organization of the sewer system

Joining pipes

①Water Surface joint



①Water Surface joint

W88

(W160)Sewerage(Joining pipes-Pipe top joint)

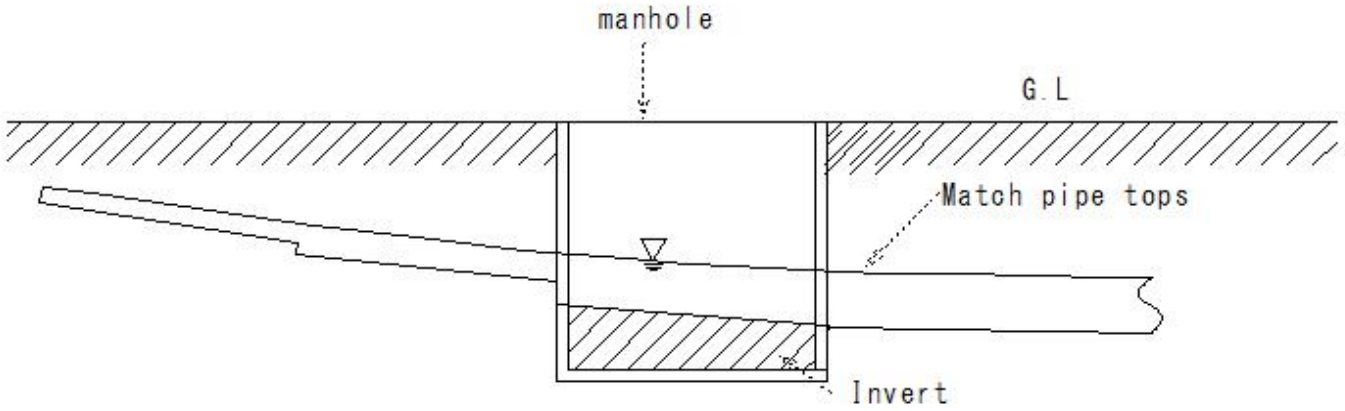
(W160)Sewerage(Joining pipes-Pipe top joint)

sewer

Organization of the sewer system

Joining pipes

②Pipe top junction



②Pipe top junction

W89

(W161)Sewerage(Joining pipes-Pipe center joint)

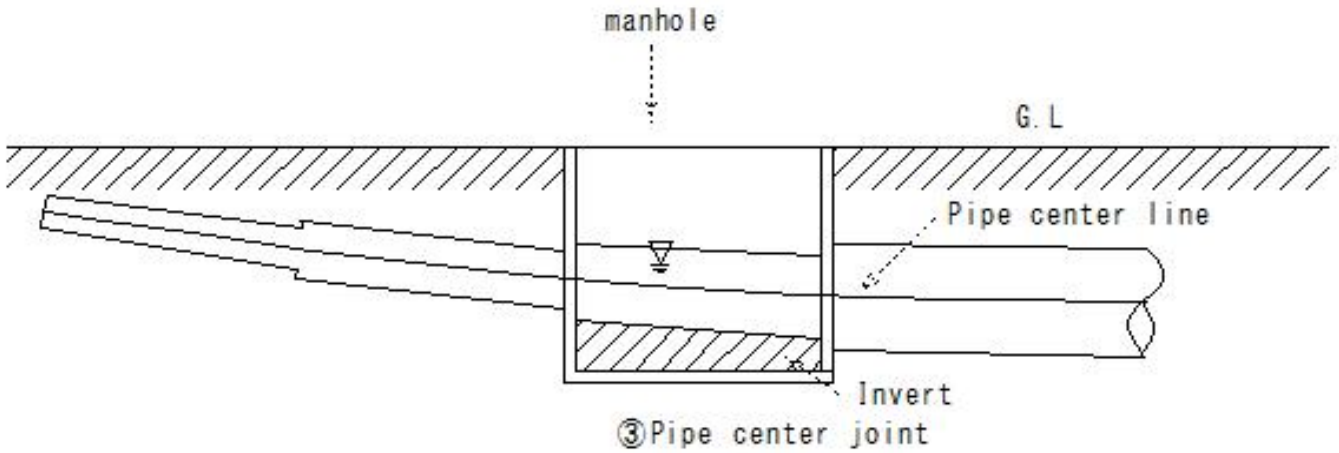
(W161)Sewerage(Joining pipes-Pipe center joint)

sewer

Organization of the sewer system

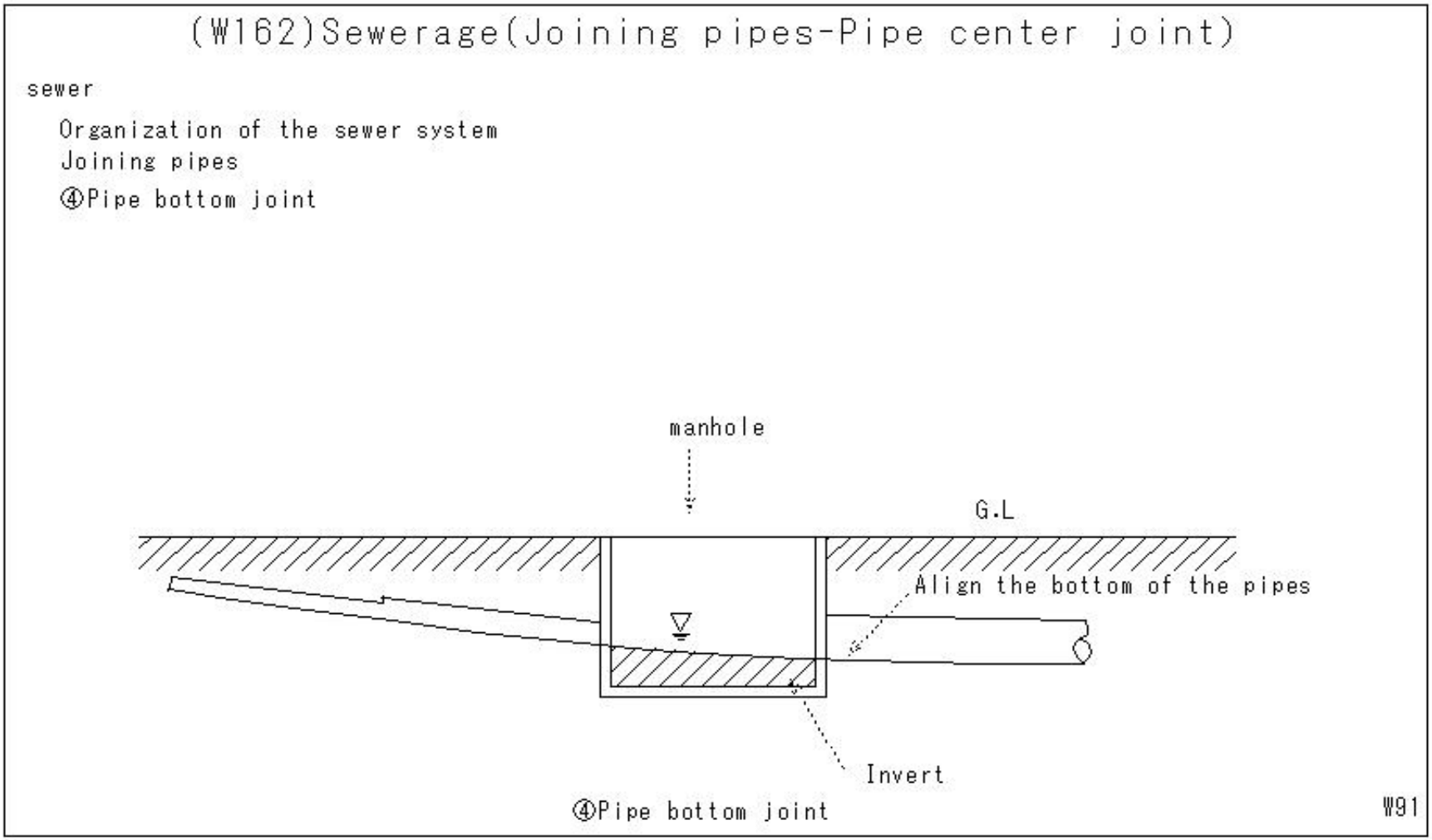
Joining pipes

③Pipe center joint



W90

(W162)Sewerage(Joining pipes-Pipe center joint)



(W163)Sewerage(Foundation work for sewer pipes）

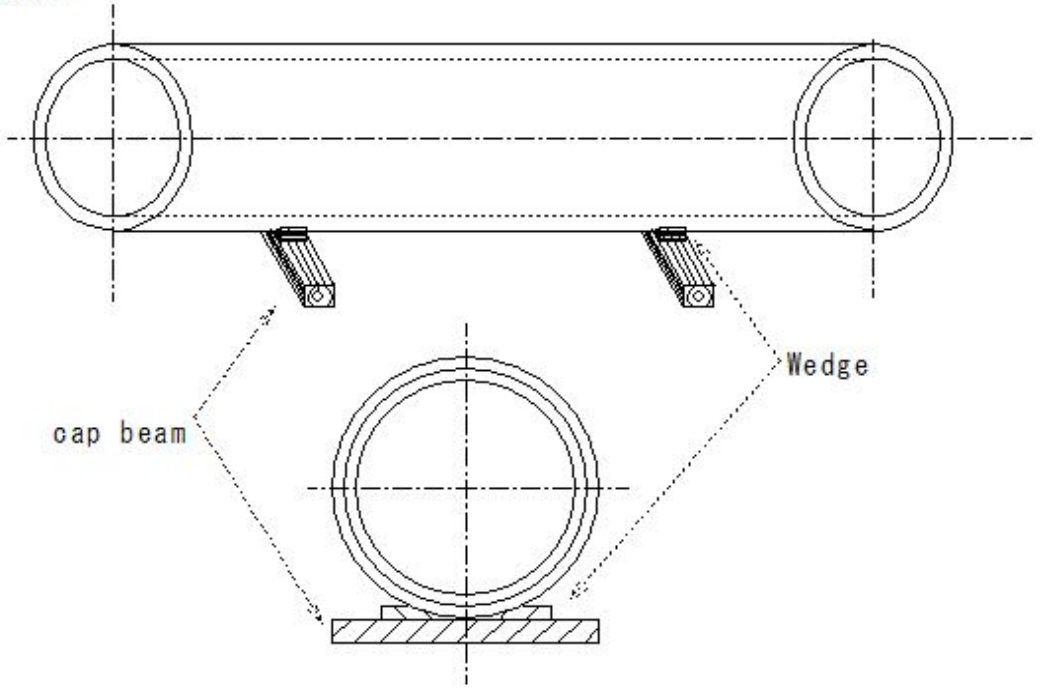
(W163)Sewerage(Foundation work for sewer pipes)

Sewerage

Sewerage structure

Foundation work for sewer pipes

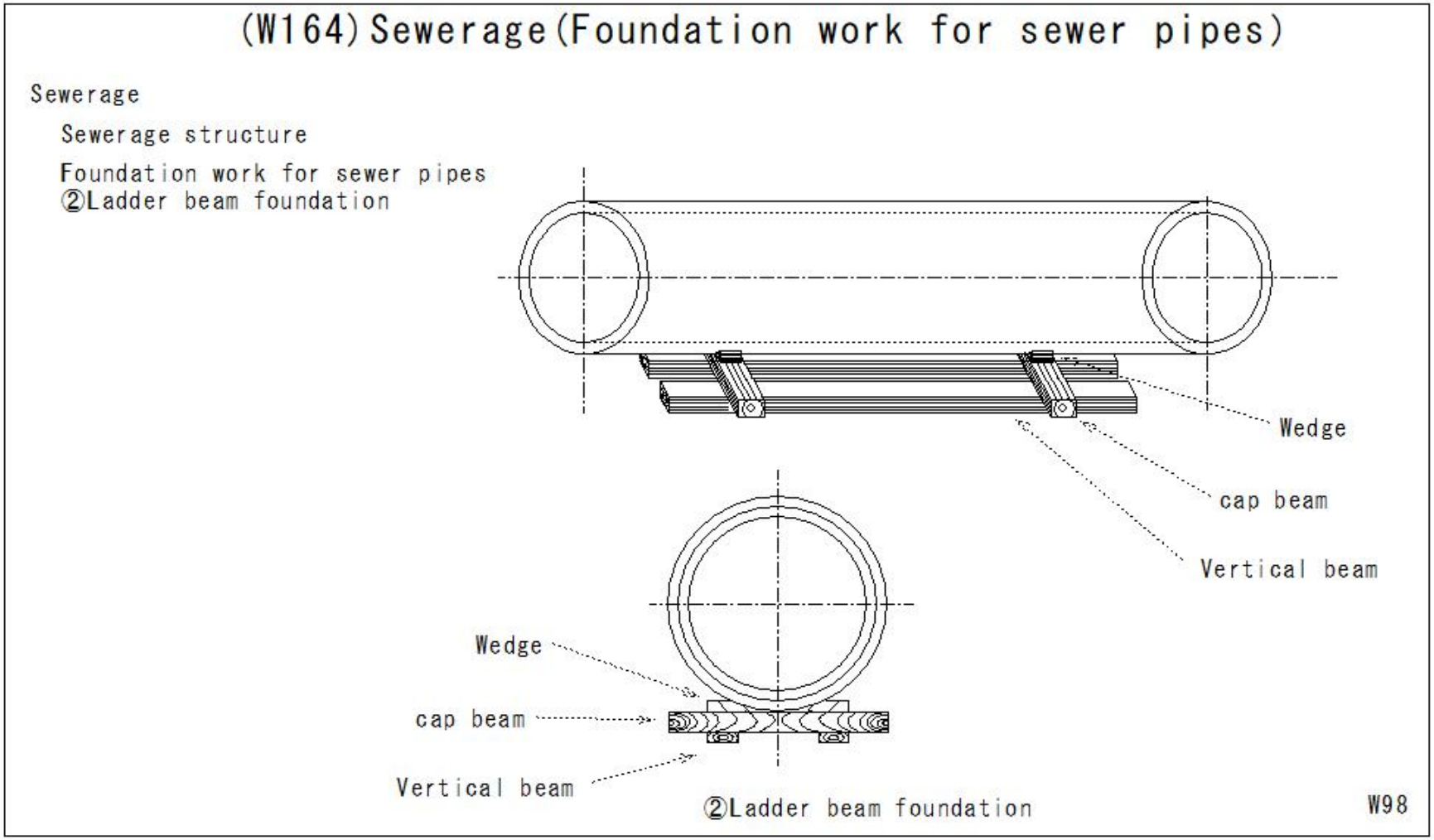
①Pile-driven cap beam foundation



①cap beam

W96

(W164)Sewerage(Foundation work for sewer pipes）



(W165)Sewerage(Foundation work for sewer pipes）

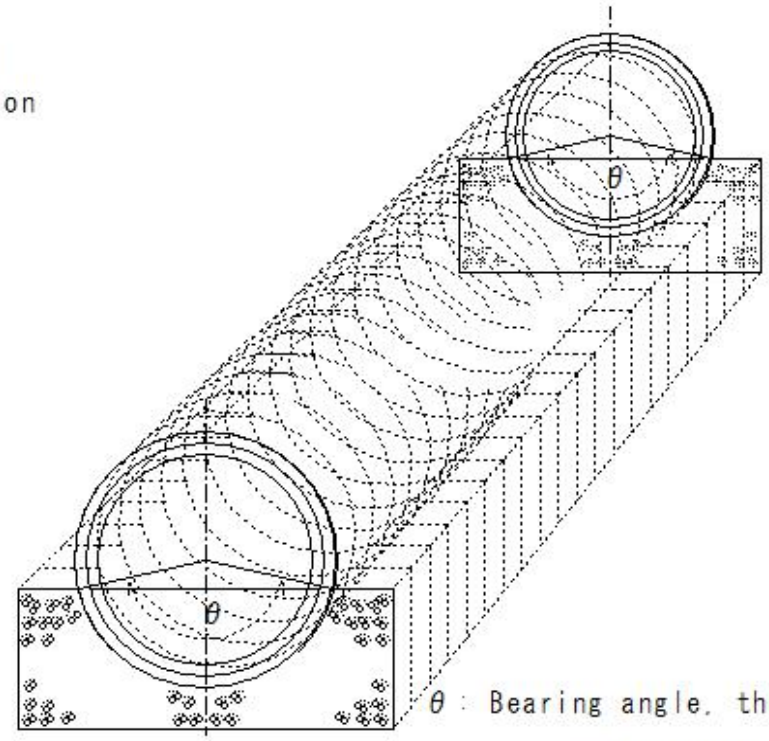
(W165)Sewerage(Foundation work for sewer pipes)

Sewerage

Sewerage structure

Foundation work for sewer pipes

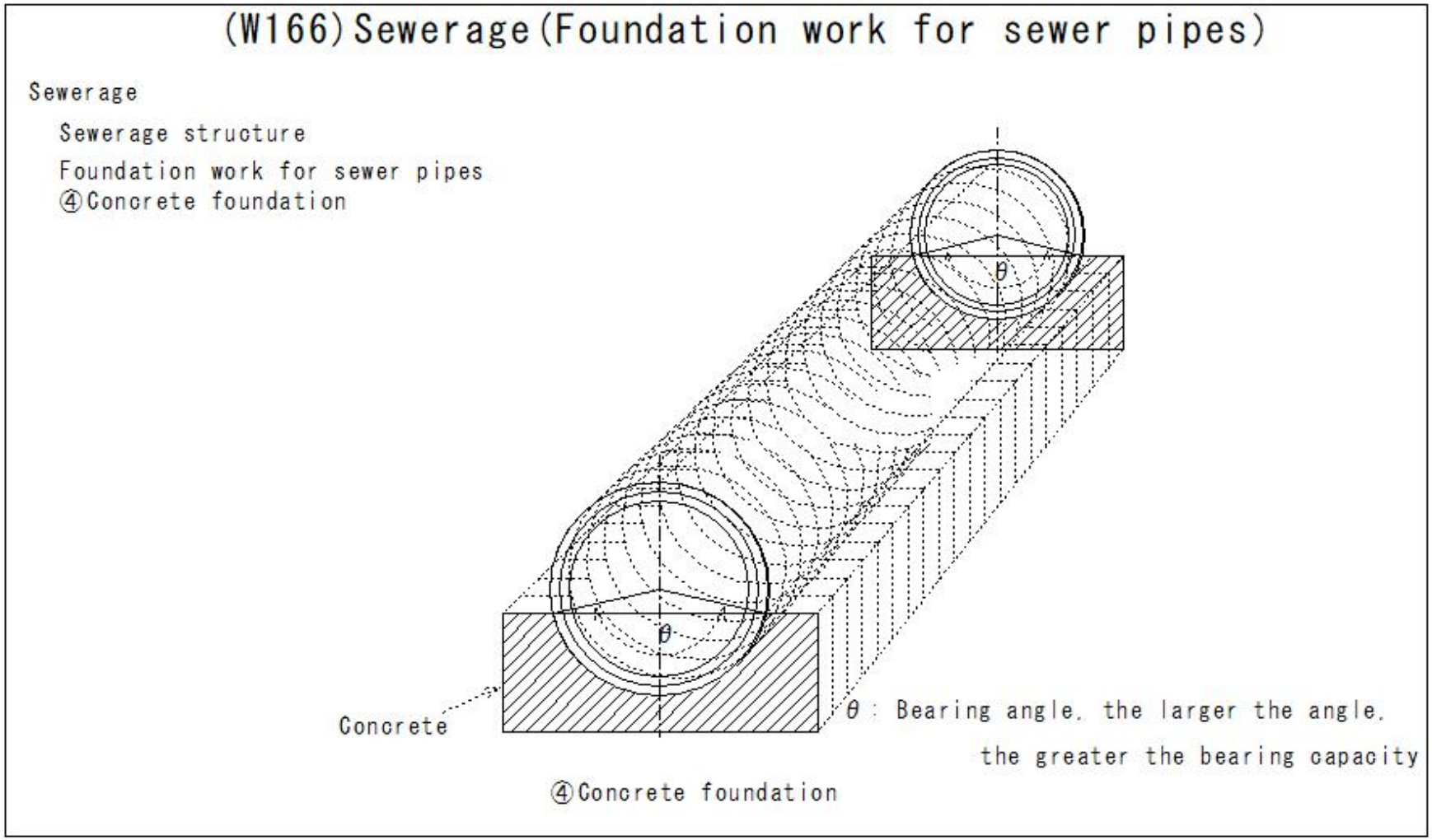
③Gravel, crushed stone foundation



θ : Bearing angle, the larger the angle, the greater the bearing capacity

③Gravel, crushed stone foundation

(W166)Sewerage(Foundation work for sewer pipes）

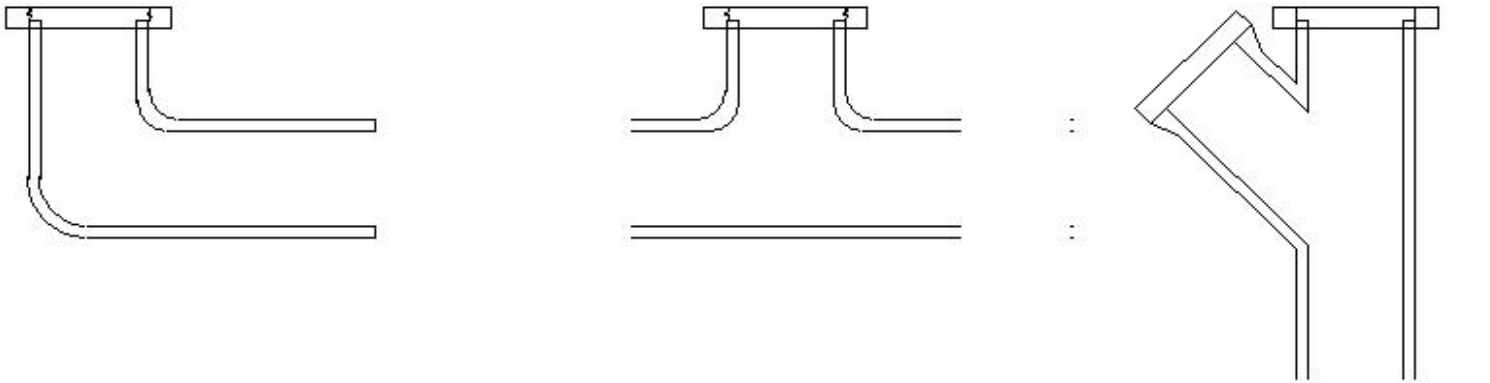


(W167)Water supply and sewerage

(W167)Water supply and sewerage

Water supply and sewerage

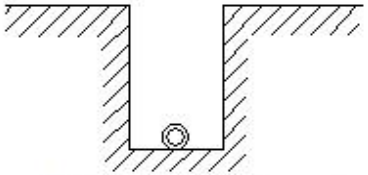
irregular pipes



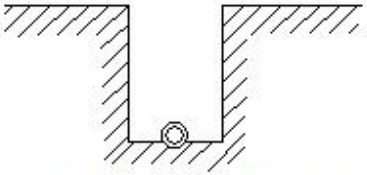
(W168)Water supply(waterworks-Bearing)

(W168)Water supply(waterworks-Bearing)

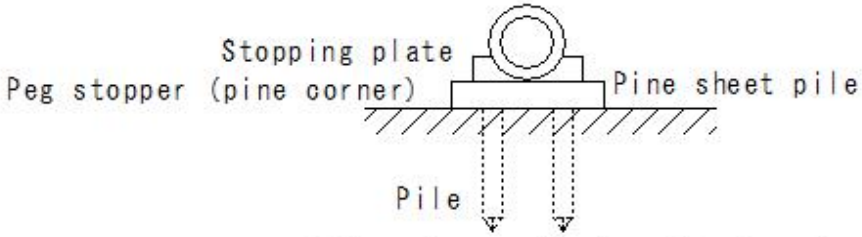
waterworks-Bearing



①Flat bottom bearing



②Circular arc bearing



③Pine sheet pile leveling bearing

W28

(W169)sewer(Centrifugal Reinforced Concrete Pipe-Joint Methods)

(W169)sewer(Centrifugal Reinforced Concrete Pipe-Joint Methods)

sewer

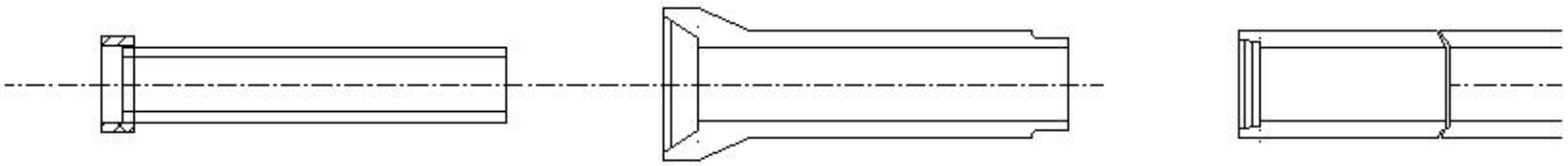
Centrifugal Reinforced Concrete Pipe

Joint Methods

A-shape: Color fitting

Type B: Socket Fitting

C-shape: wax joint



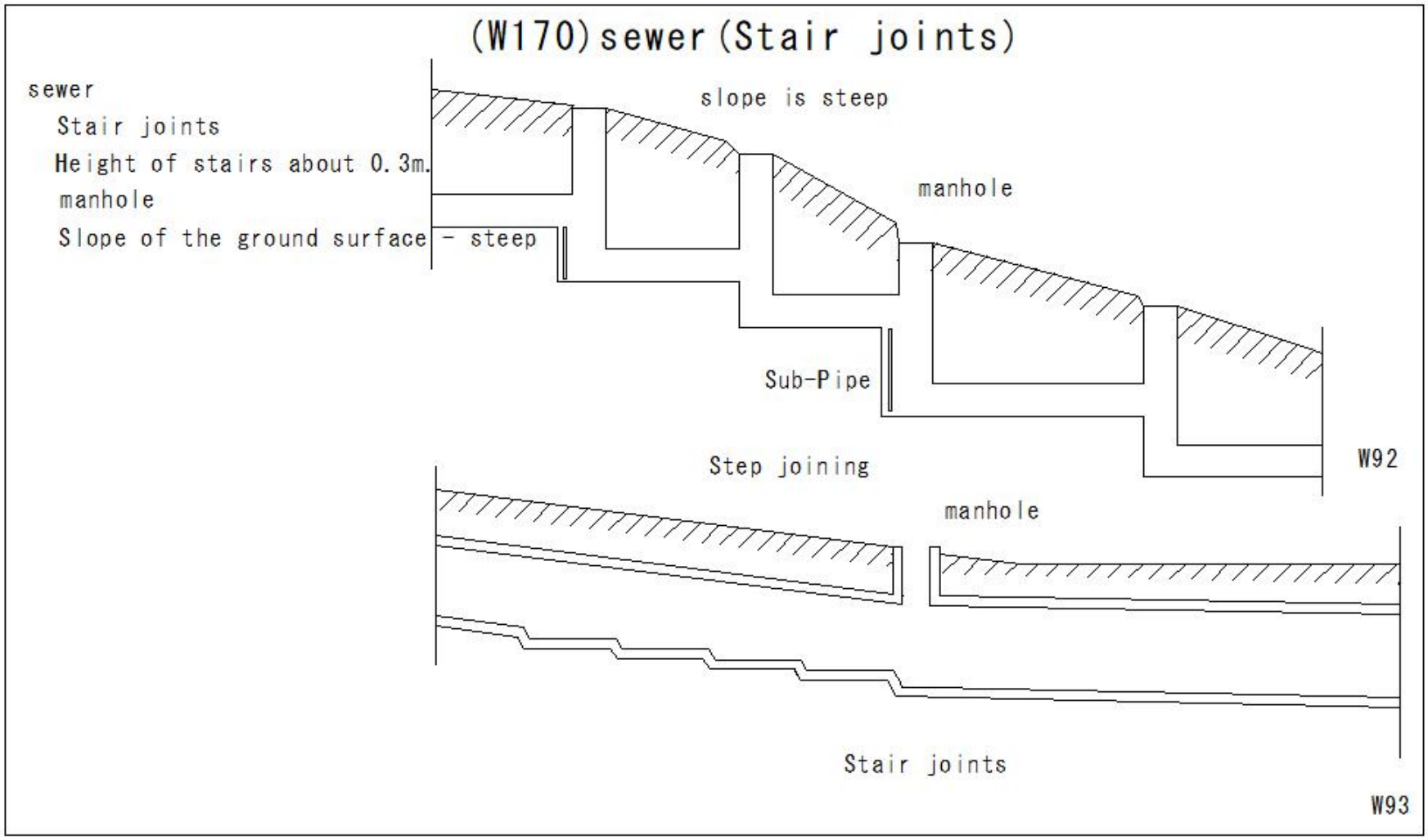
① Collar joints

② Socket joints

③ Spigot joints

W95

(W170)sewer(Stair joints)



(W171)sewer(Activated sludge method)

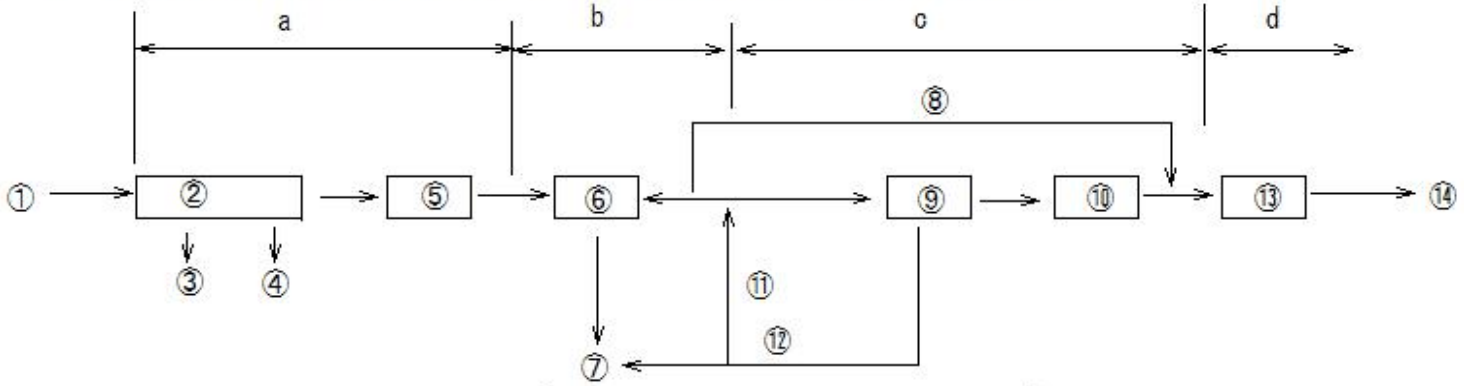
(W171) sewer (Activated sludge method)

sewer

Activated sludge method

- Sewage water treatment
- Add microorganisms
- Air is pumped in by aeration
- Using the action of aerobic microorganisms
- Methods for oxidizing, agglomerating, and precipitating organic matter

a Preliminary treatment
b Primary treatment
c Secondary treatment
d Sterilization treatment



① Inflow
② sand basin (sedimentation basin)
③ Garbage: landfill or incineration
④ Sand: landfill
⑤ Preliminary aeration tank
⑥ Primary sedimentation tank
⑦ To sludge treatment
⑧ Sewage from combined sewer system during storms
⑨ Aeration tank
⑩ Final sedimentation tank
⑪ Return sludge
⑫ Excess sludge
⑬ Chlorine mixing tank
⑭ Discharge

W135

(W172)sewer(Slow filtration method)

(W172)sewer(Slow filtration method)

Sewerage

Slow filtration method

Rivers: Purify groundwater to drinkable water

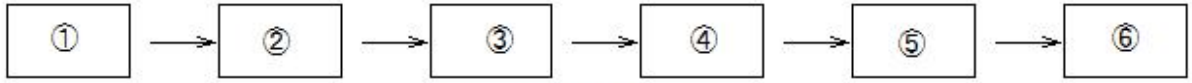
Colloidal or higher components - coagulation and separation

Raw water annual average turbidity: 10 degrees or less

BOD: 2 ppm or less

Coliform bacteria (per 1000 ml): 1000 or less

Rapid filtration method



Rapid filtration method

①Receiving well

②plain precipitation(Normal sedimentation)pond

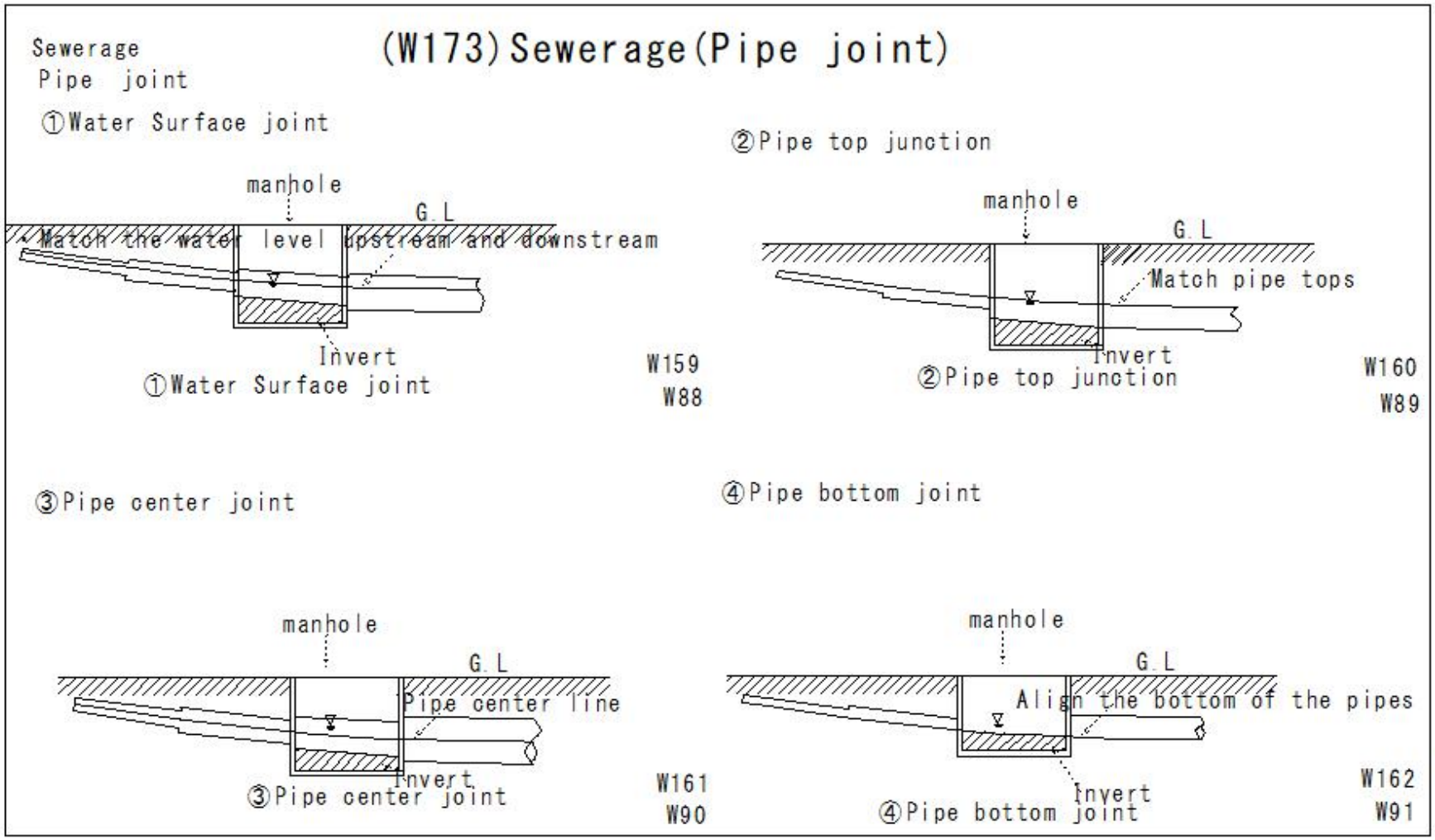
③Slow filtration pond

④Chlorine disinfection room

⑤Clean water pond

⑥Sewage pond

(W173)Sewerage(Pipe joint)

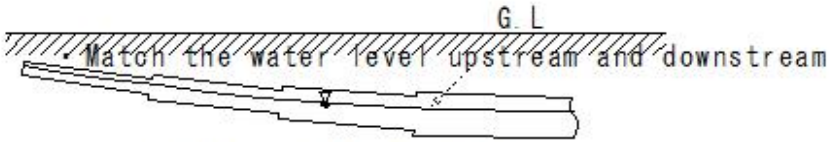


(W174)Sewerage(Pipe joint)

(W174)Sewerage(Pipe joint)

Sewerage
Pipe joint

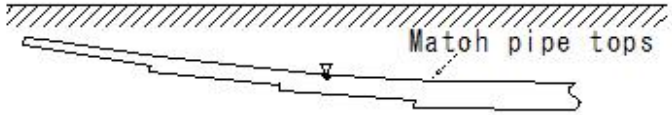
①Water Surface joint



①Water Surface joint

W88

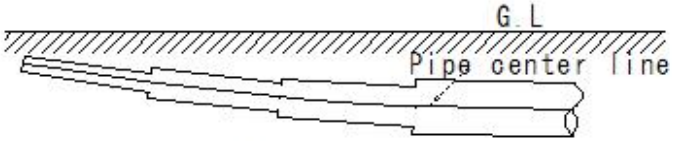
②Pipe top joint



②Pipe top joint

W89

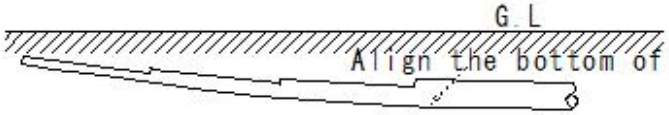
③Pipe center joint



③Pipe center joint

W90

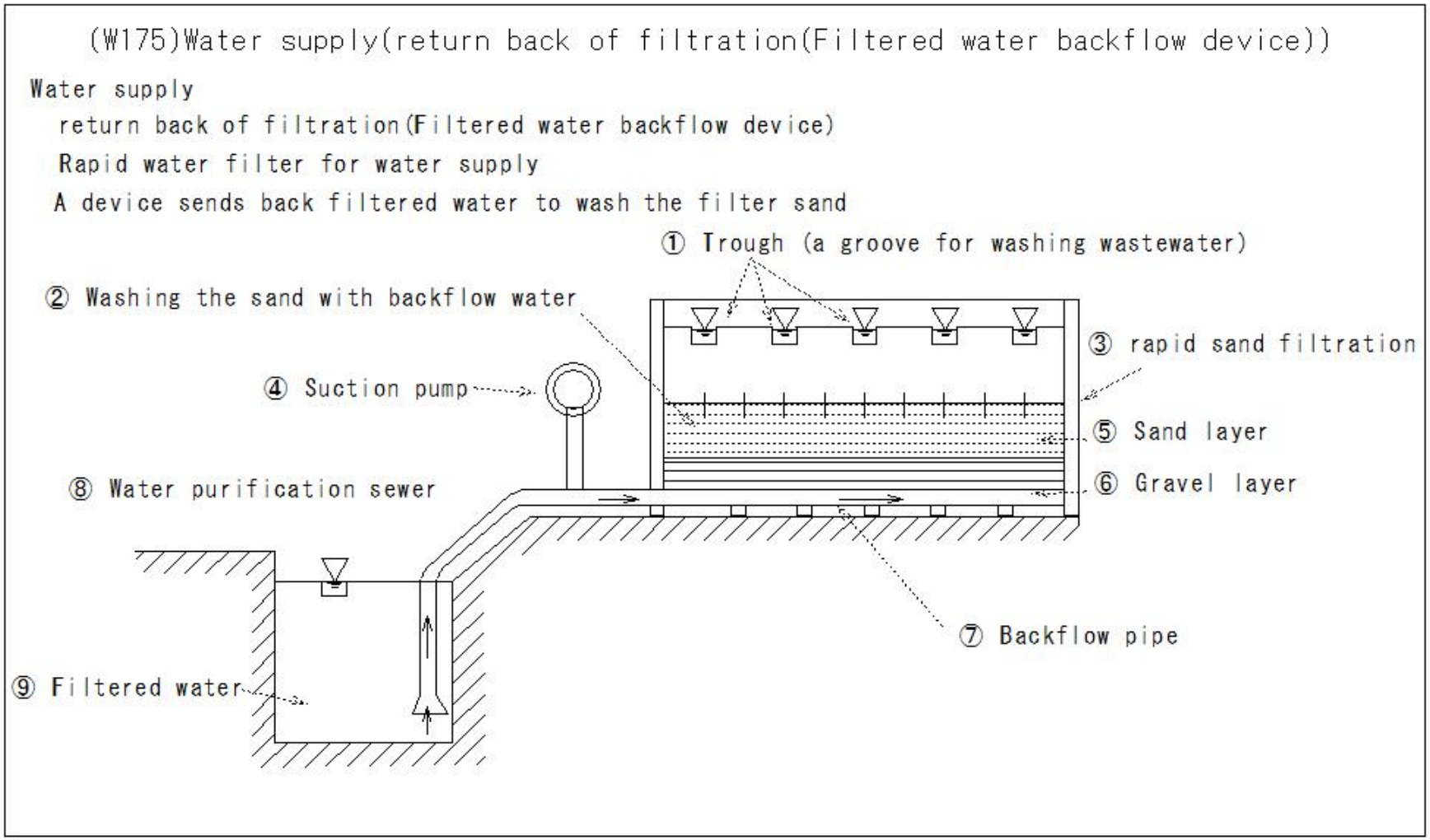
④Low pipe joints



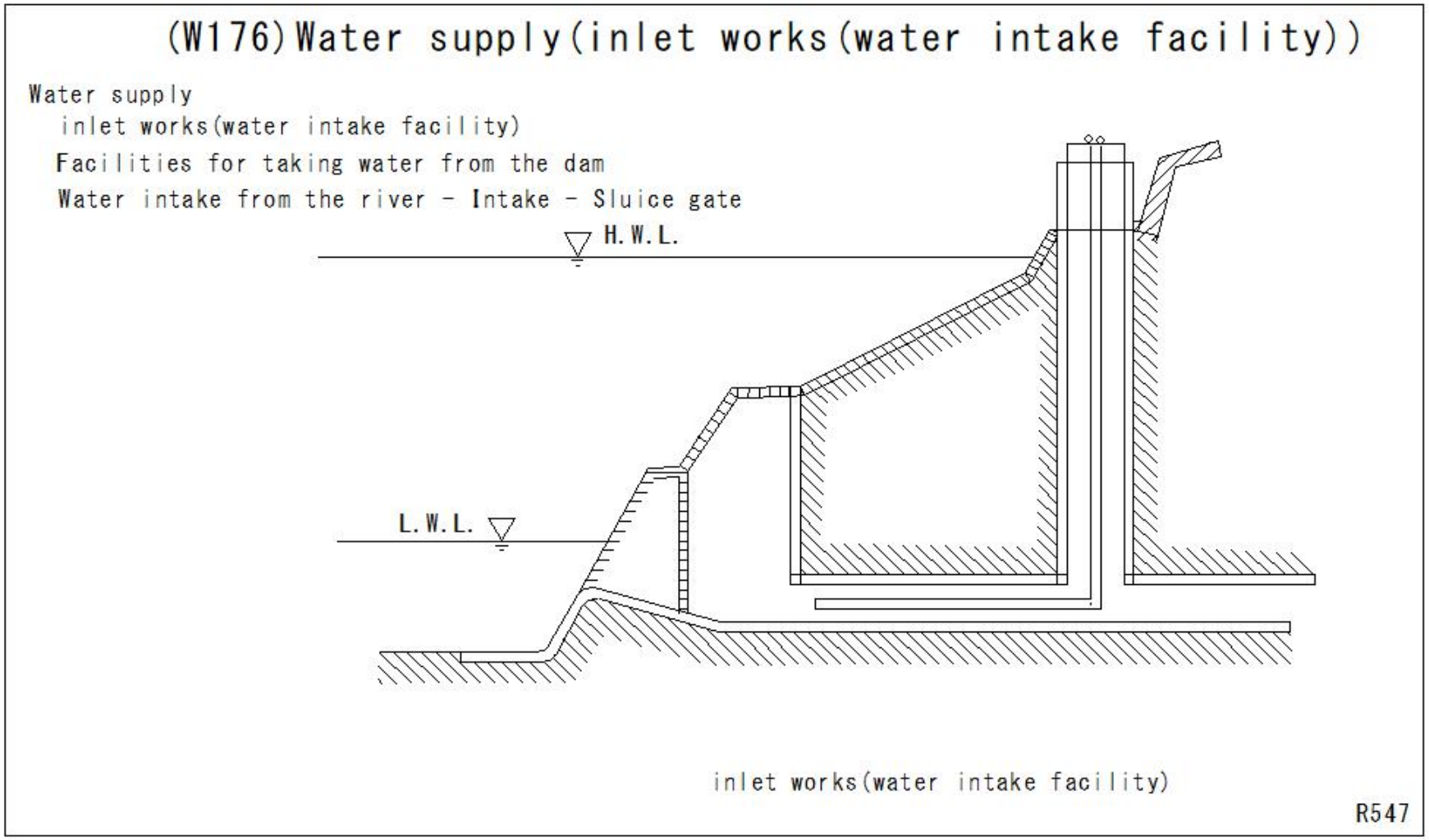
④Low pipe joints

W91

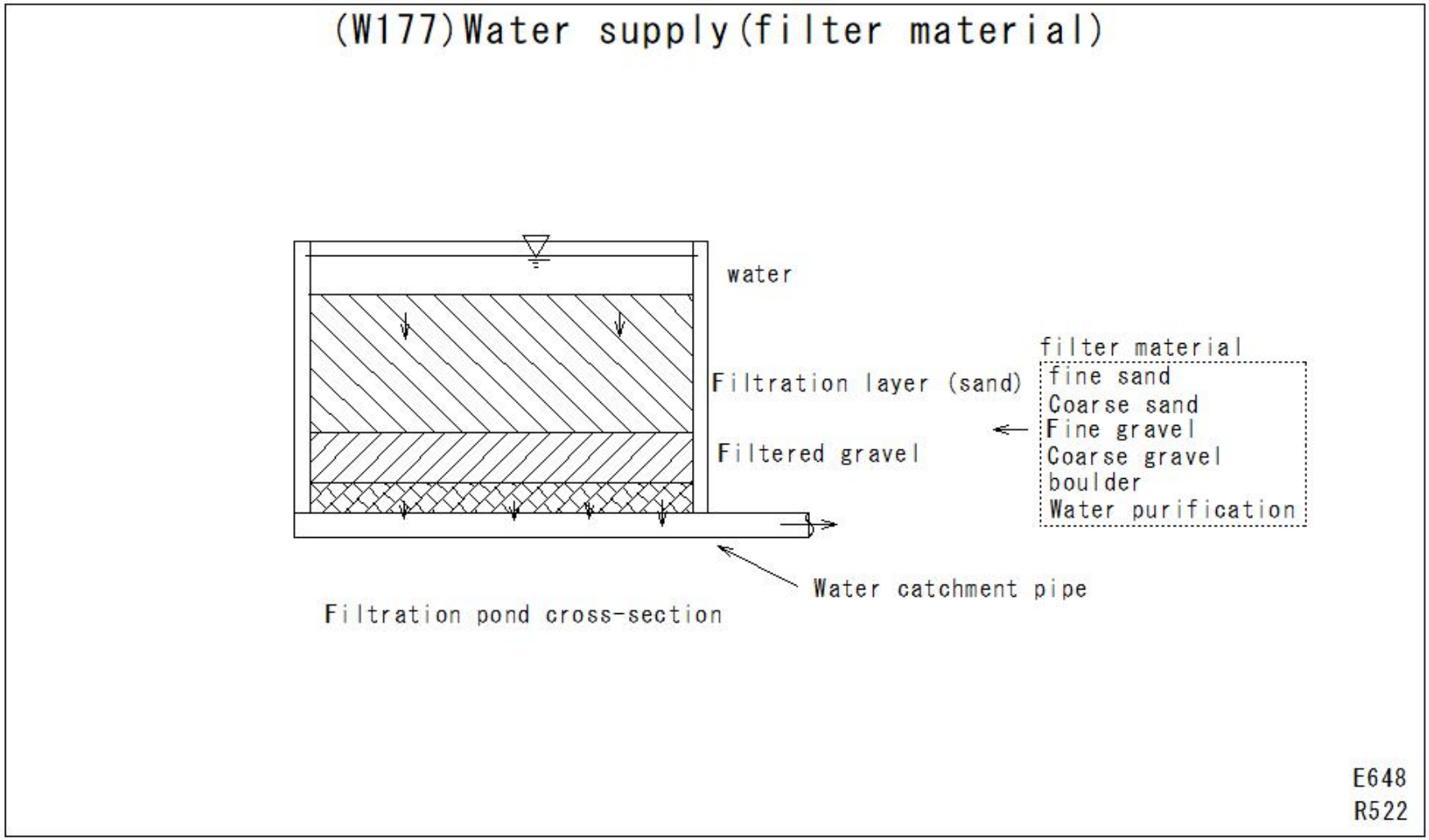
(W175)Water supply(return back of filtration(Filtered water backflow device))



(W176)Water supply(inlet works(water intake facility))



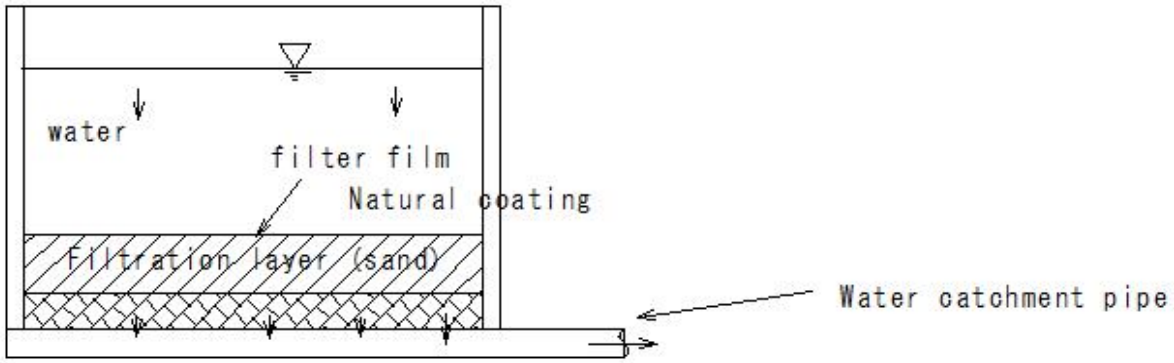
(W177)Water supply(filter material)



(W178)Water supply(filter film)

(W178)Water supply(filter film)

Water supply(filter film)



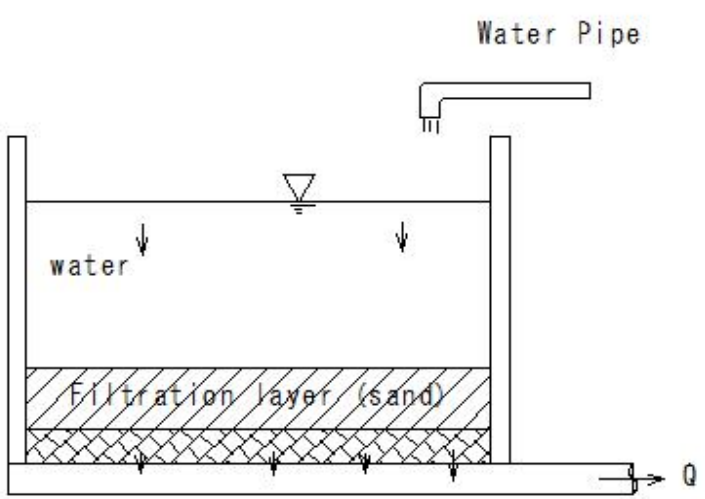
Filtration pond cross-section

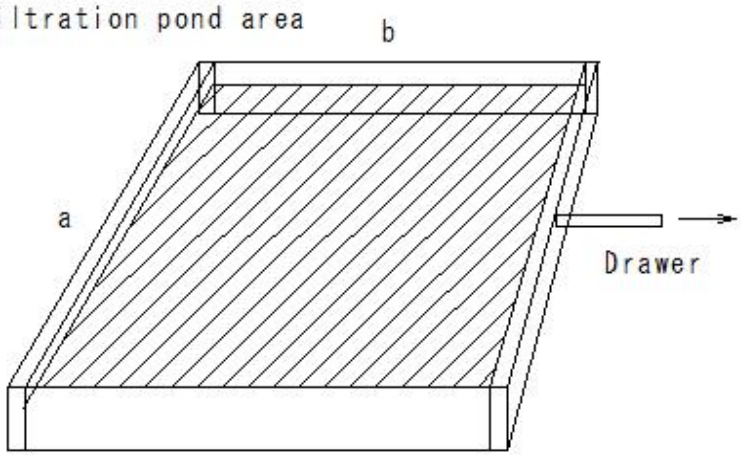
R521
E647

(W179)Water supply(rate of filtration)

(W179)Water supply(rate of filtration)

rate of filtration





Filtered water volume

rate of filtration(Q)

Unit: m3/day

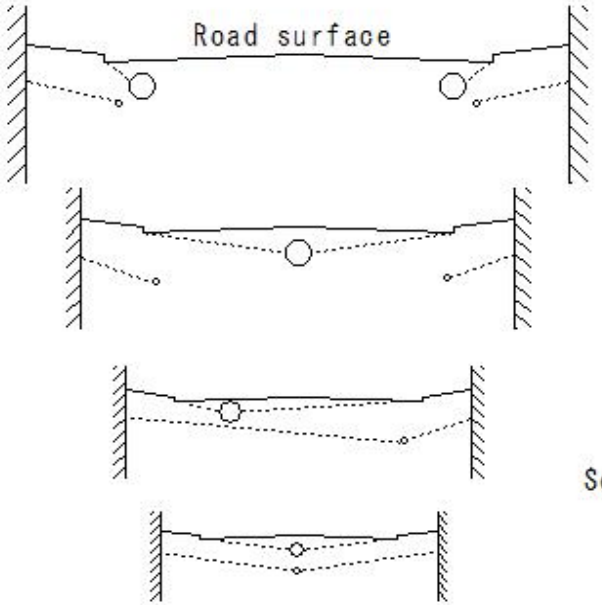
rate of filtration(Q)=Daily filtration rate／Filtration pond area=Q/ab(m3/day)

R520
E646

(W180)Sewerage(separate system)

(W180) Sewerage (separate system)

Separate sewer(separate system) pipe layout method



Separate type

○ : Large circle: water pipe

∘ : Small circle: sewage pipe

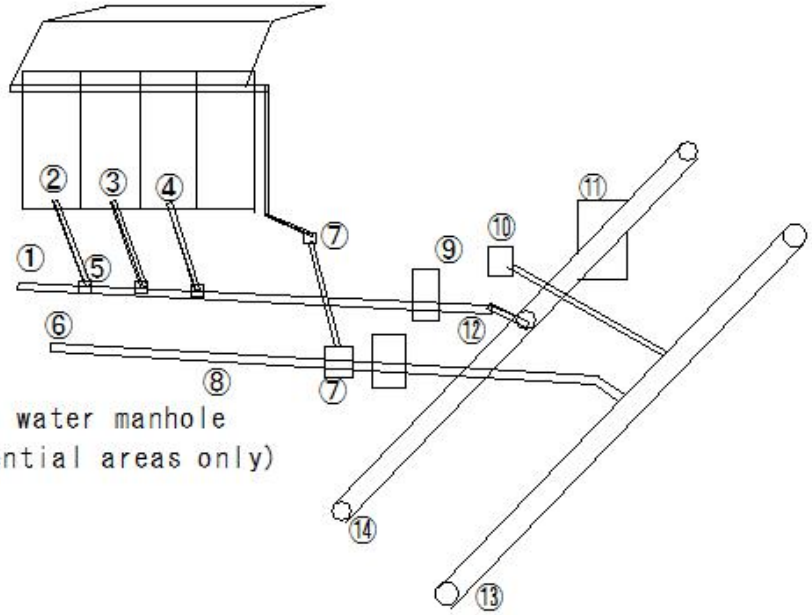
W66

(W181)Sewerage(separate system)

(W181)Sewerage(separate system)

Sewerage

Separate type



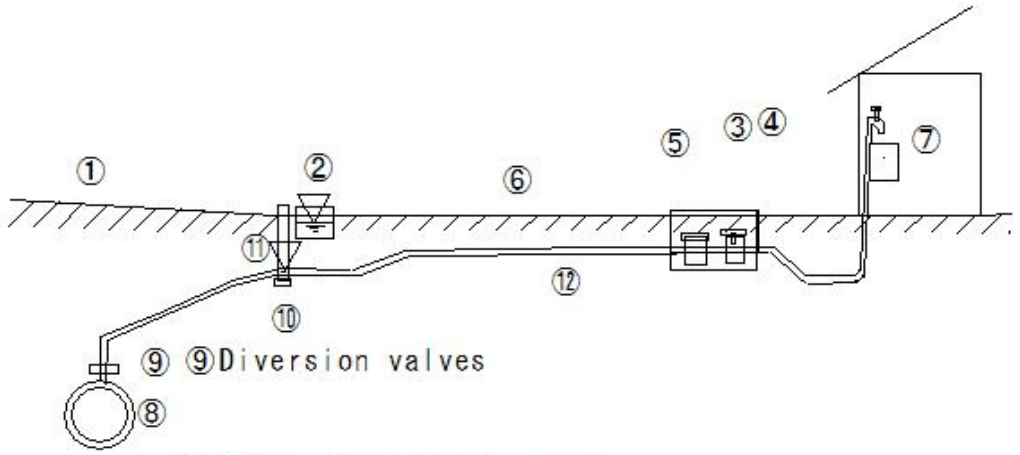
① Water distribution pipe (sewage pipe)
② Kitchen
③ Bathroom
④ Toilet
⑤ Sewage manhole
⑥ Drainage pipe (storm water pipe) Storm water manhole
⑦ Public storm water manhole (for residential areas only)
⑧ Rainwater attachment pipe
⑨ Public sewage manhole
⑩ Public storm water manhole
⑪ Sewage manhole
⑫ Sewage attachment pipe
⑬Sewer pipes (rain water pipes)
⑭ Sewer pipes (sewage pipes)

(W182)Sewerage(Water distribution valve(ferrule))

(W182)Sewerage(Water distribution valve(ferrule))

Water distribution valve(ferrule)

A device is installed in case of branching off a water supply pipe from a distribution pipe



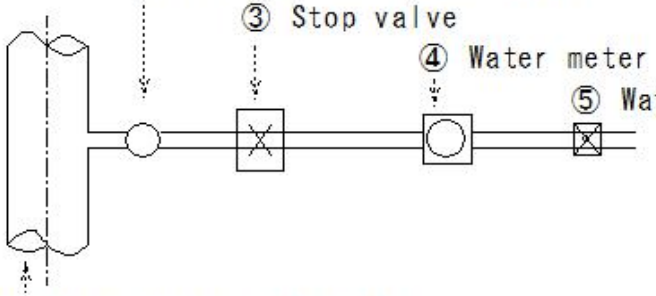
W49,50

② Water distribution valve

③ Stop valve

④ Water meter

⑤ Water supply valve



① Water distribution pipe

(W183)Sewerage(Flocculator-Slow speed agitator)

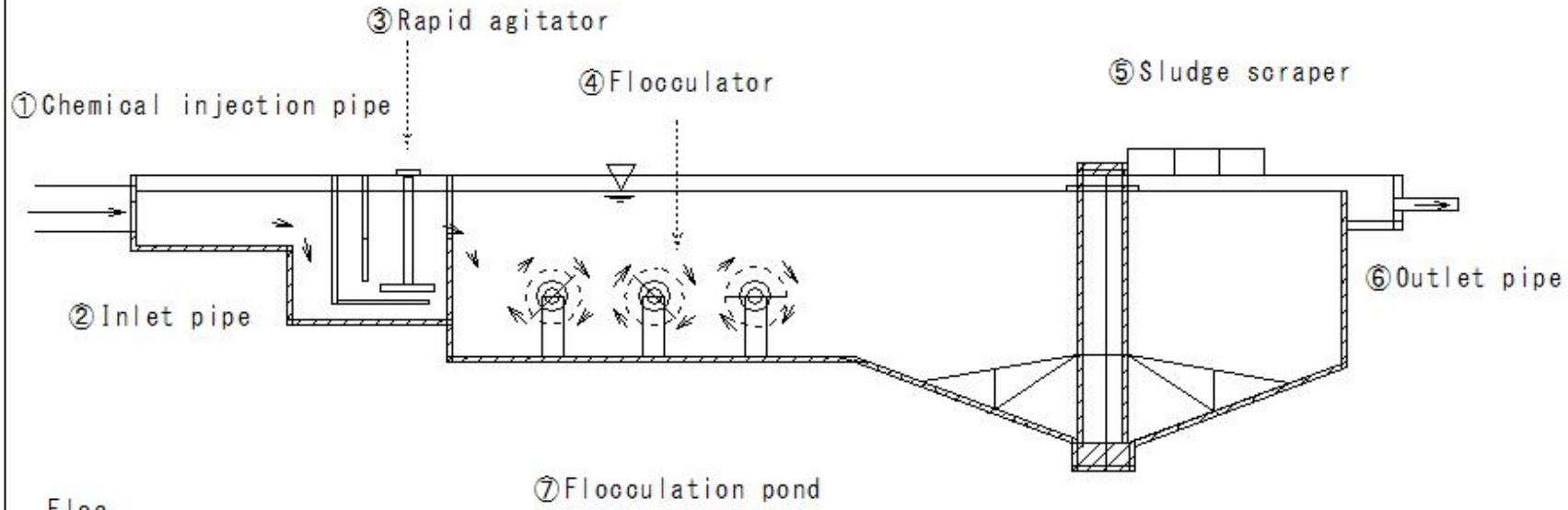
(W183)Sewerage(Flocculator-Slow speed agitator)

Flocculator

Slow-speed agitator

Water purification device that mixes the injected chemicals (aluminum sulfate) with the water to create flocs (aluminum hydroxide)

The settled sludge is mainly mechanically dehydrated



Floc

By adding a flocculant, the metal hydroxides in the form of feathers on the sea surface are formed.

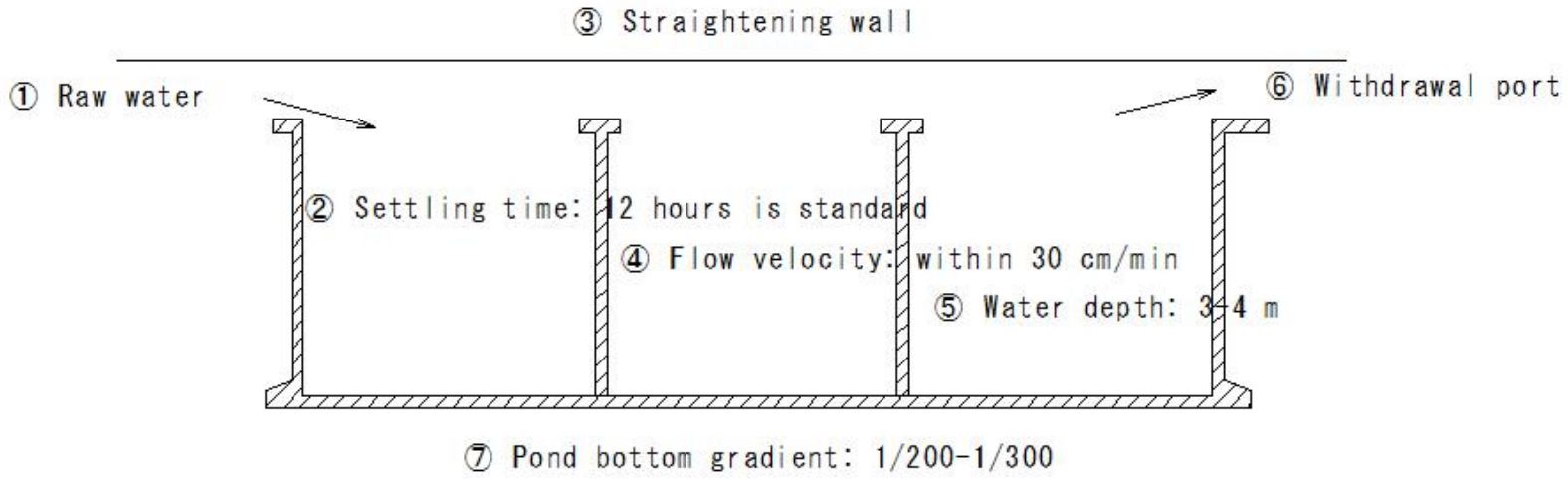
(W184)Water supply(plain precipitation）

(W184)Water supply(plain precipitation)

plain precipitation (Normal sedimentation)

One of the sedimentation methods used in water purification plants

A sedimentation method in which water is led into a large pond, the flow rate is slowed or stopped, and suspended matter is allowed to settle by gravity alone

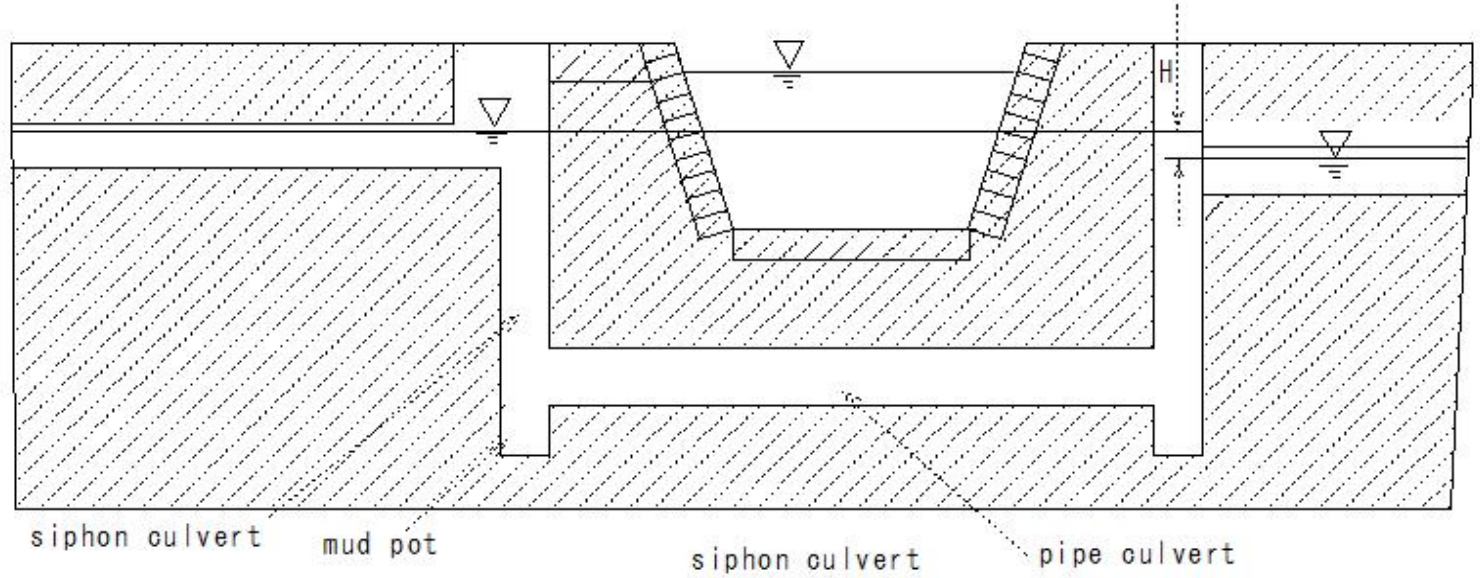


(W185)Sewerage(siphon culvert)

(W185)Sewerage(siphon culvert)

siphon culvert

Waterways that cross under waterways, railways, and roads



R612

(W186)Sewerage(Anaerobic digestion)

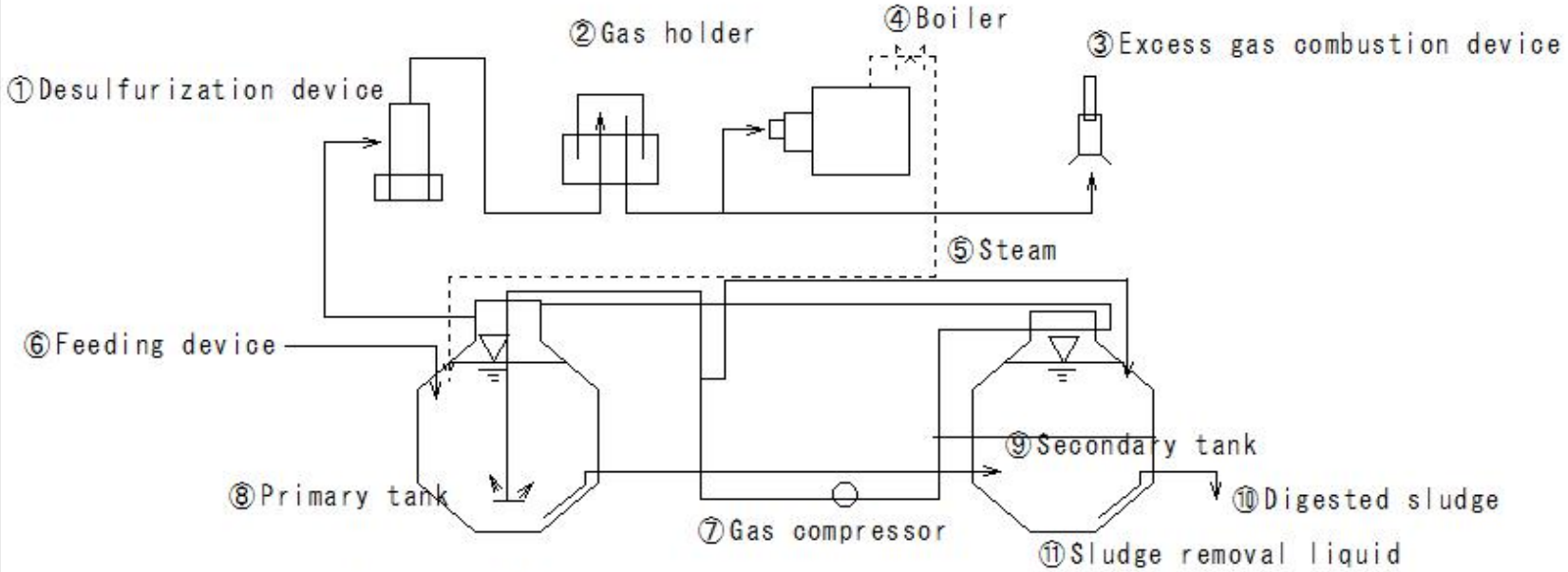
(W186)Sewerage(Anaerobic digestion)

Sewerage

Anaerobic digestion

Sludge treatment method

- In an environment without oxygen
- Biodegradation method of organic matter
- Organic matter in sludge after sewage treatment is decomposed by anaerobic bacteria



Example of flow sheet for sludge digestion (two-stage digestion)

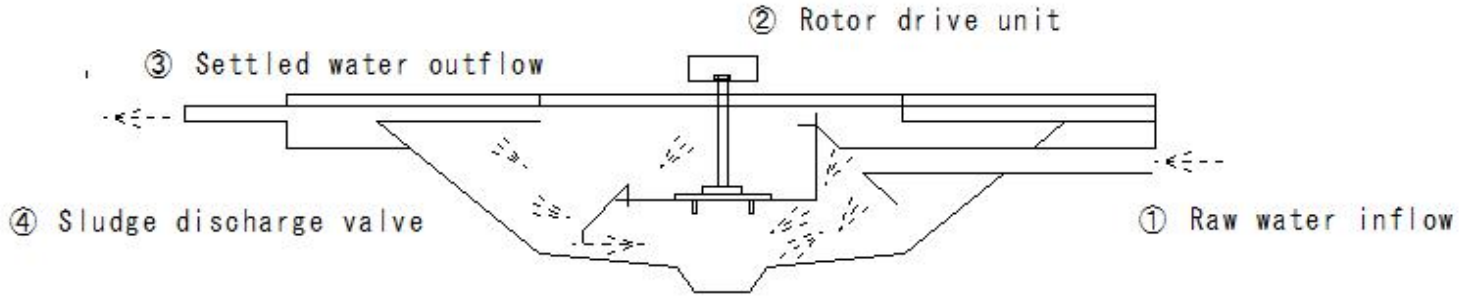
(W187)Water supply(High-speed coagulation and sedimentation tank)

(W187)Water supply(High-speed coagulation and sedimentation tank)

Water supply

High-speed coagulation and sedimentation tank

a High-speed coagulation and sedimentation tank (slurry circulation type)



a High-speed coagulation and sedimentation tank (slurry circulation type)

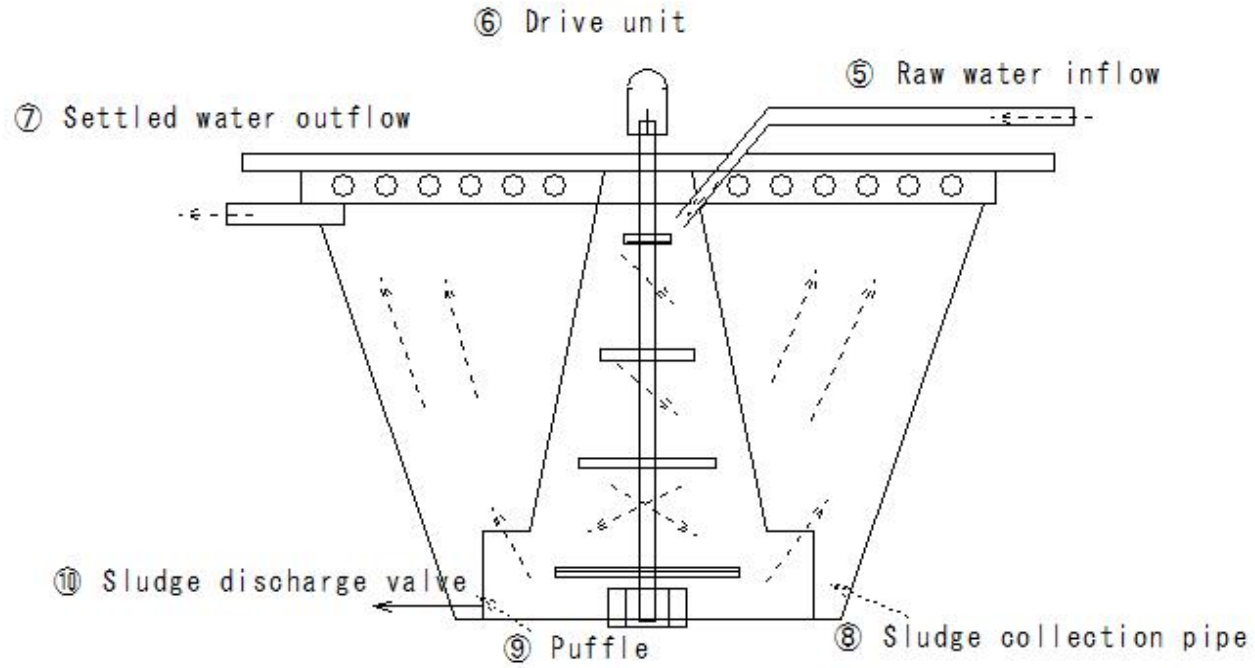
(W188)Water supply(High-speed coagulation and sedimentation tank)

(W188)Water supply(High-speed coagulation and sedimentation tank)

Water supply

High-speed coagulation and sedimentation tank

b High-speed coagulation and sedimentation tank (sludge blanket type)



b High-speed coagulation and sedimentation tank (sludge blanket type)

(W189)Water supply(surface washing（Surface cleaning）)

(W189)Water supply(surface washing (Surface cleaning))

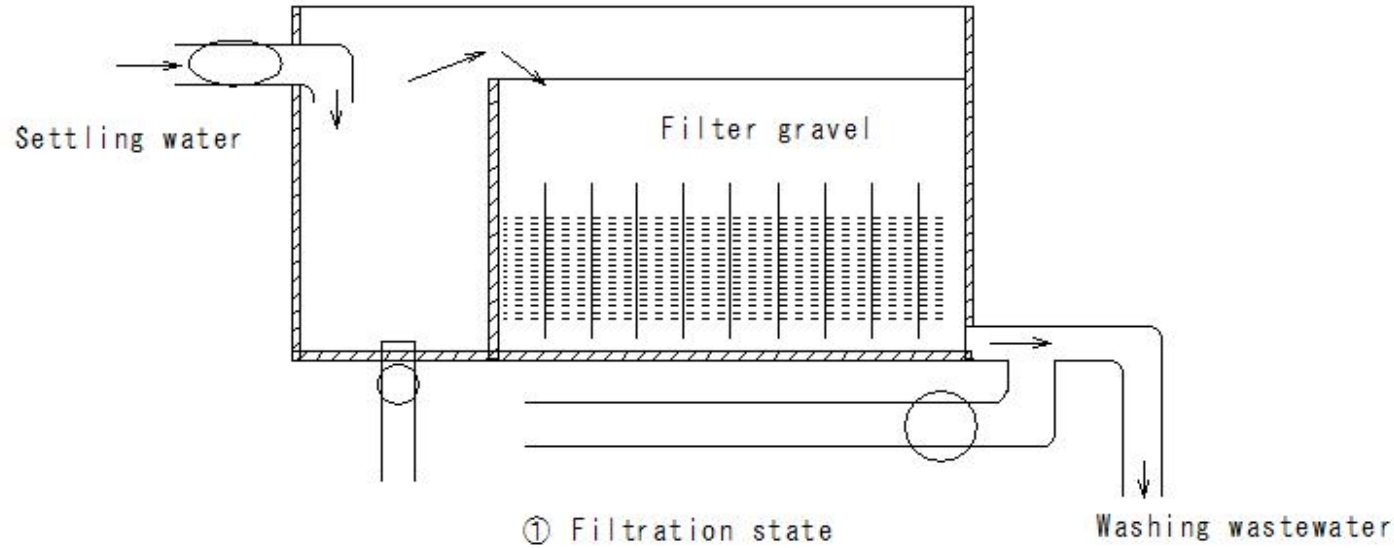
surface washing (Surface cleaning)

Rapid filtration of water supply

Backwash cleaning of filter pond

Sand layer surface - spraying cleaning water

Rotary



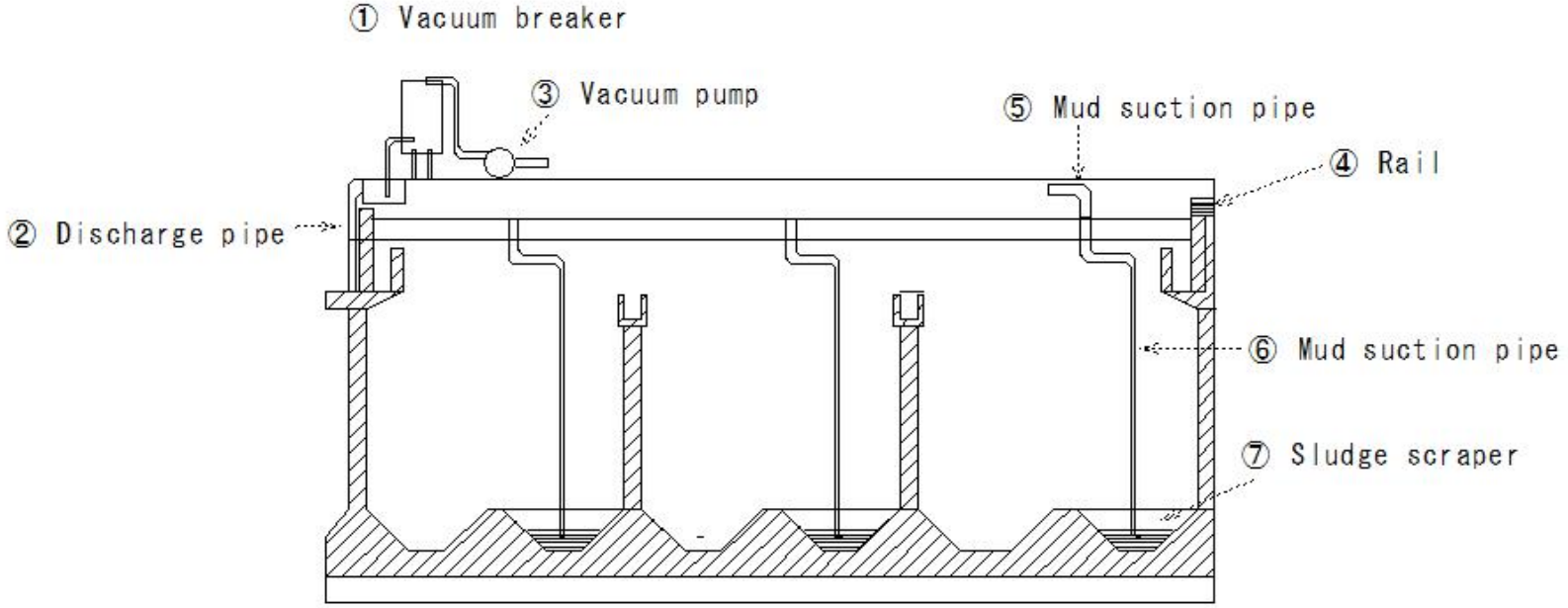
(W190)Sewerage(Final sedimentation tank)

(W190)Sewerage(Final sedimentation tank)

Sewerage

Final sedimentation tank

A tank that separates treated water from sludge generated by biological treatment in sewage



Final sedimentation tank

(W191)Water supply(Minimum hydraulic gradient line)

(W191)Water supply(Minimum hydraulic gradient line)

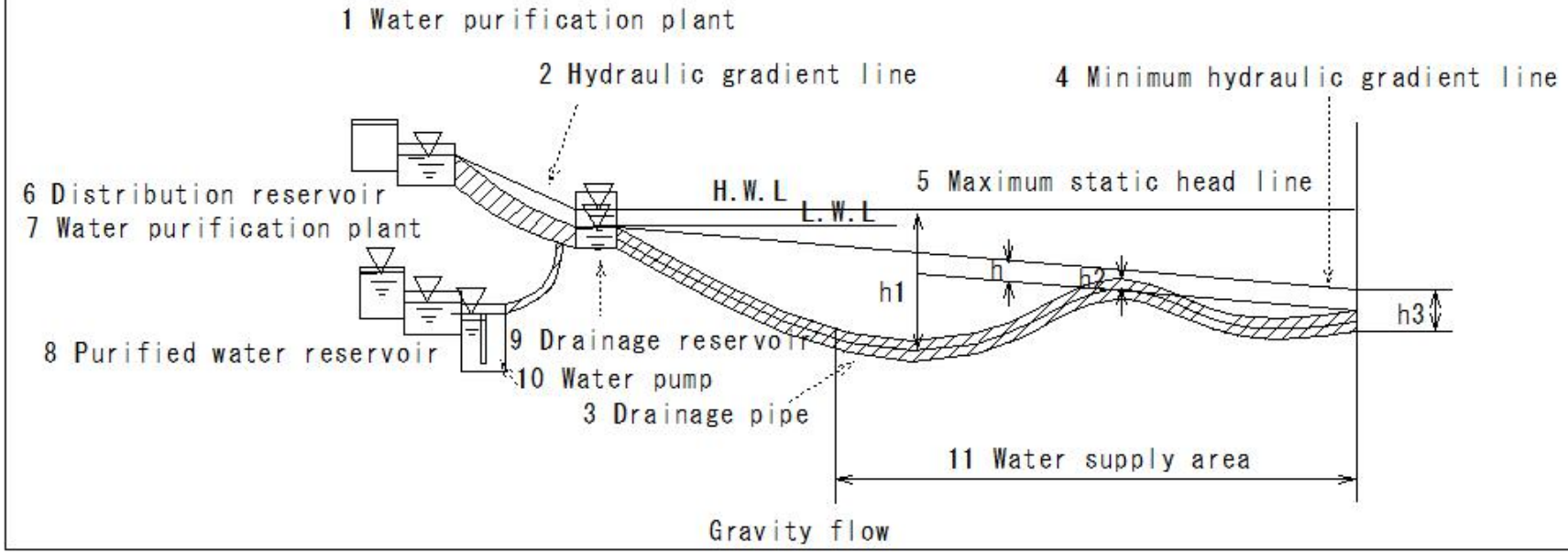
Water supply

Minimum hydraulic gradient line

・Water supply pipe

Pipes are placed deeper than the minimum hydraulic gradient line to prevent wastewater from entering the pipes

a Gravity flow



(W192)Water supply(Minimum hydraulic gradient line)

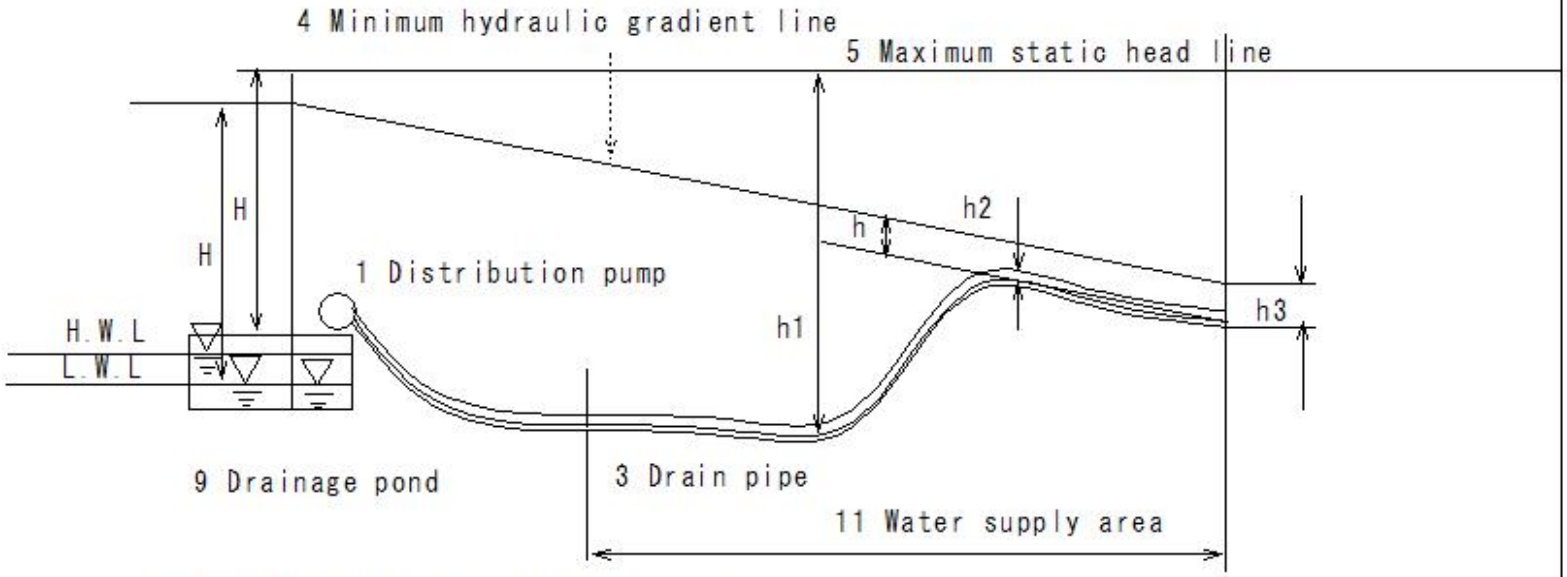
(W192)Water supply(Minimum hydraulic gradient line)

Water supply

Minimum hydraulic gradient line

・Water supply pipe

Pipes are placed deeper than the minimum hydraulic gradient line to prevent wastewater from entering the pipe



H = Total head of distribution pump

h = Minimum allowable head

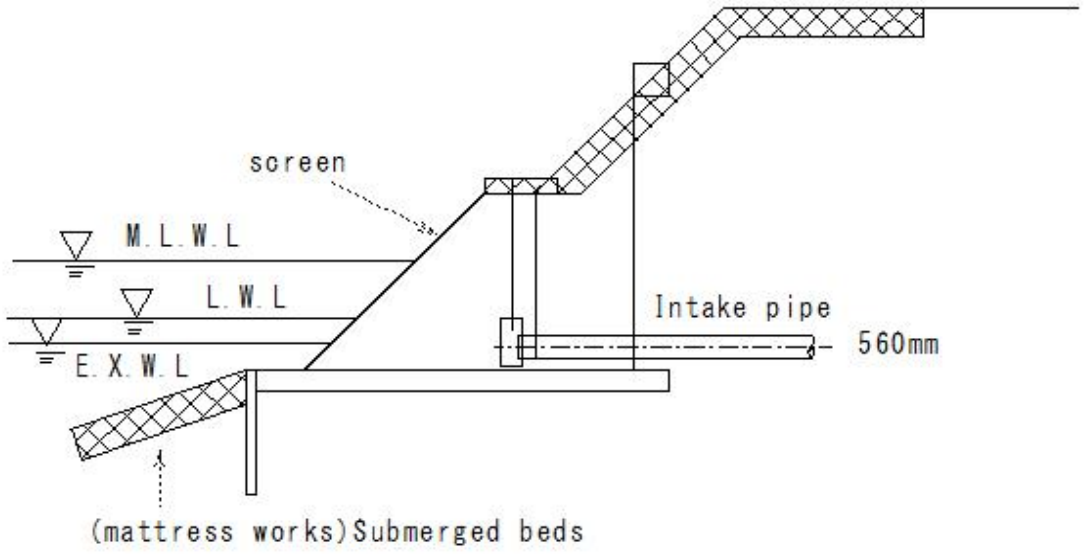
b Pump pressure type

(W193)Water supply(Intake pipe)

(W193)Water supply(Intake pipe)

Water supply

- The role of sending raw water from the water supply to the water conduit
- During periods of drought, in case of the water intake position is away from the location of the water conduit.
- Water intake pipe: Fume pipe, cast iron pipe

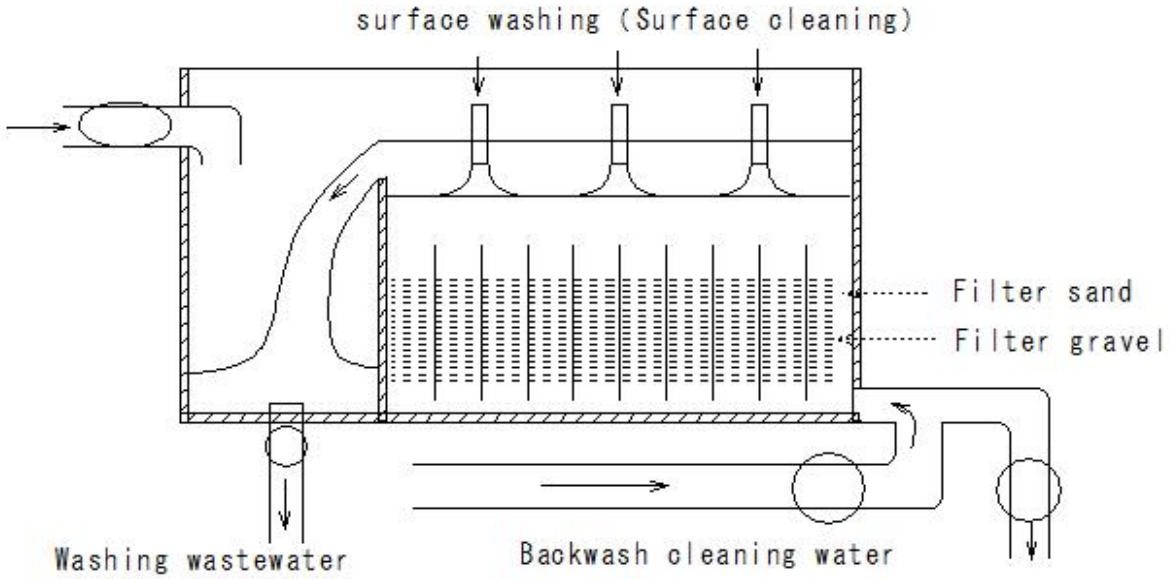


Intake pipe

(W194)Water supply(surface washing（Surface cleaning）)

(W194)Water supply(surface washing (Surface cleaning))

Water supply
surface washing (Surface cleaning)



② surface washing(Surface cleaning)

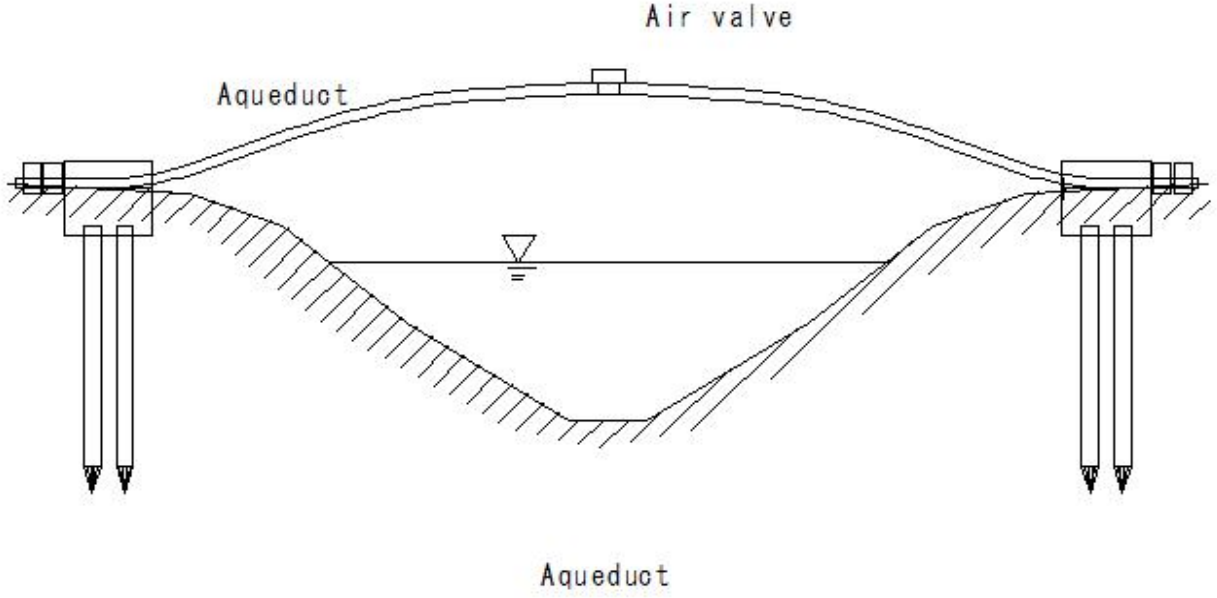
(W195)Water supply and sewerage(Aqueduct)

(W195)Water supply and sewerage(Aqueduct)

Water supply and sewerage

Aqueduct

- Cases where the pipeline itself becomes part of the bridge
- in case of installed on a bridge
- Aqueduct with arched pipelines



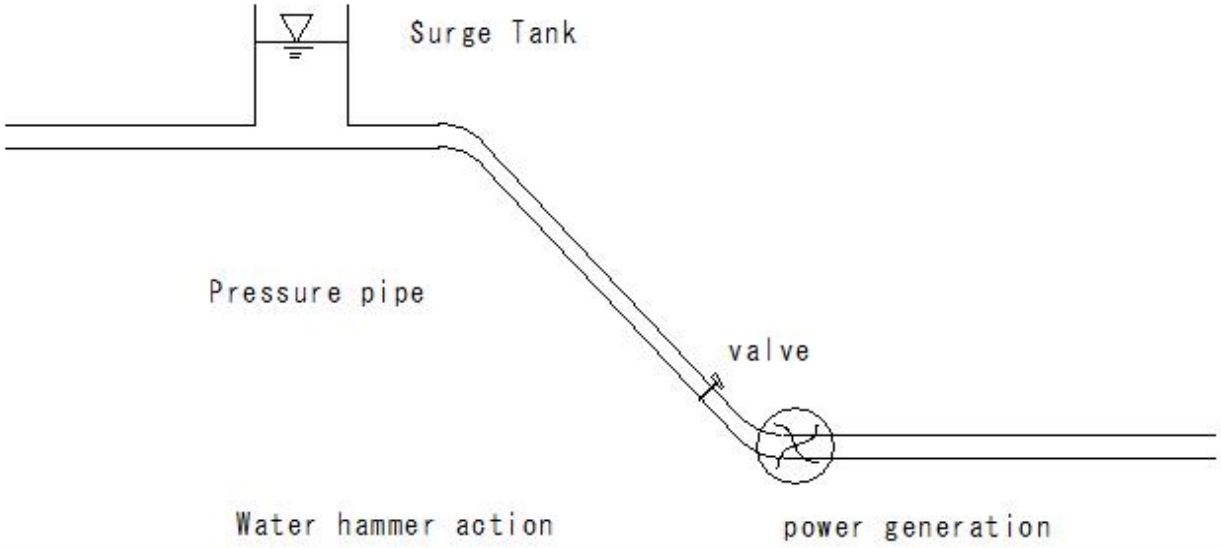
(W196)Water supply(Water hammer action)

(W196)Water supply(Water hammer action)

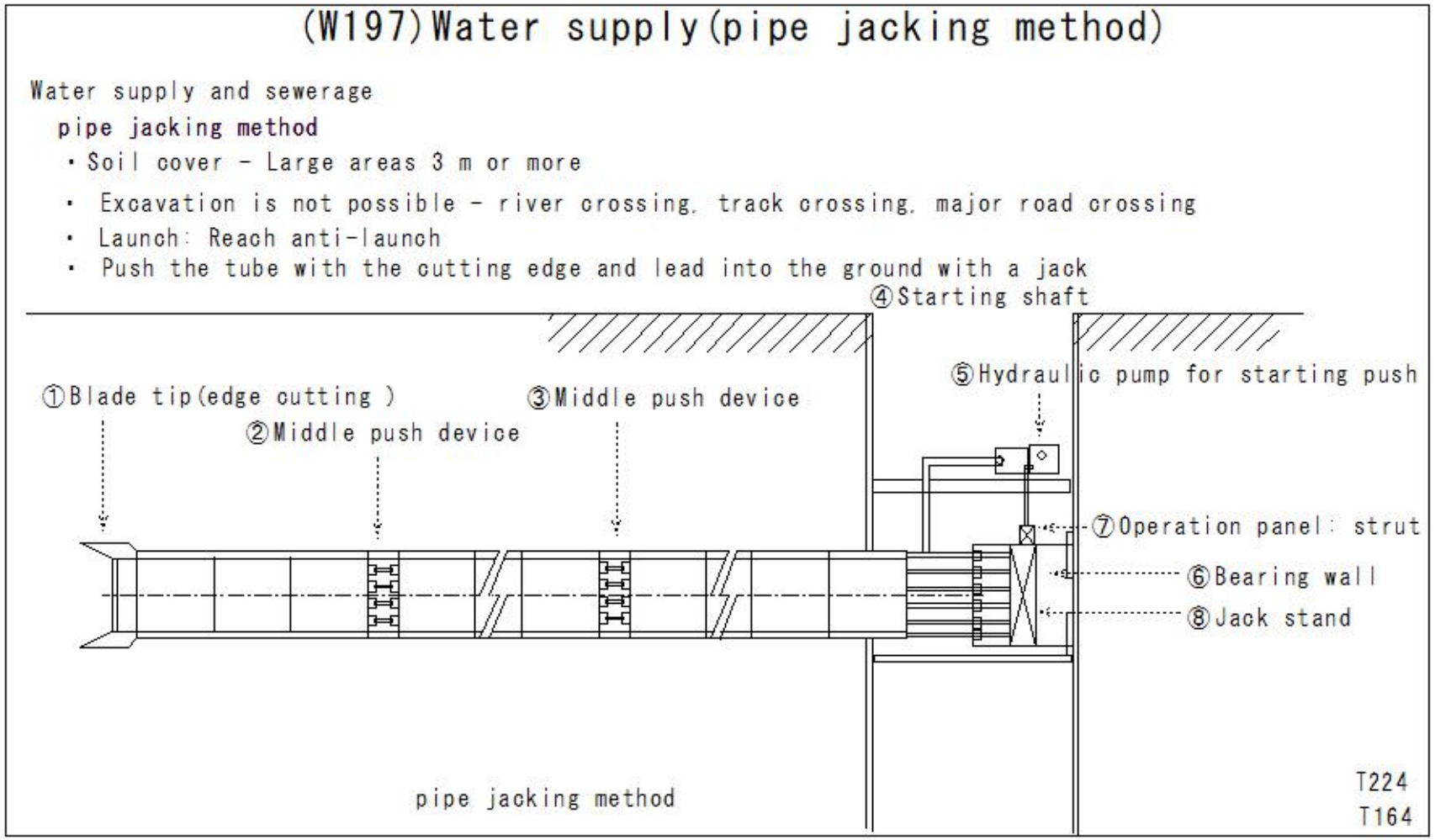
Water supply

Water hammer action

- in case of the valve of the pipe channel in the water supply is suddenly closed
- Flow velocity The head changes to water pressure.
- Acts as a water hammer
- Pipelines are designed with water hammer pressure in mind.
- Absorbs water hammer pressure
- Surge tank as a type of hydroelectric power generation facility



(W197)Water supply(pipe jacking method)

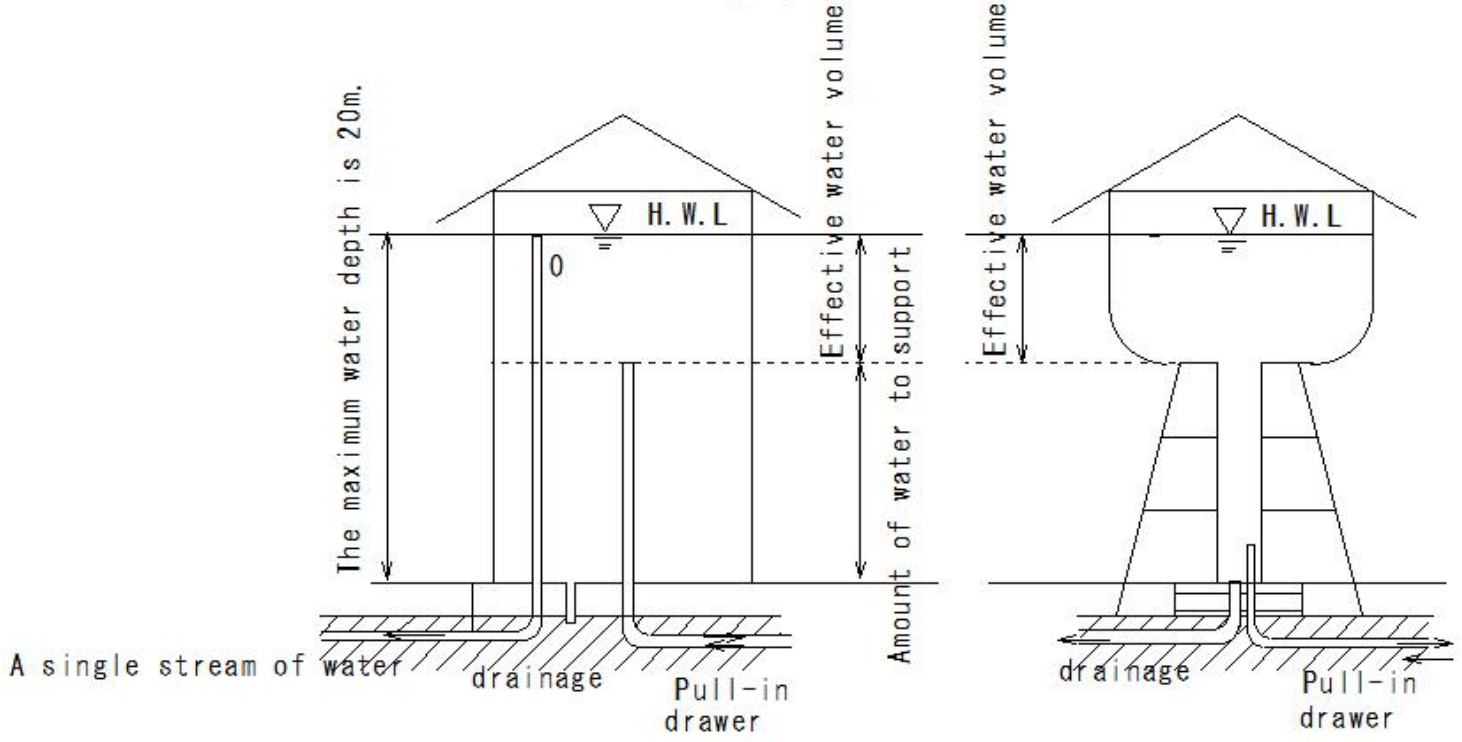


(W198)Water supply(water-tower)

(W198)Water supply(water-tower)

water-tower

Near the water supply area - in case of a suitable elevation cannot be obtained for the drainage pond, a water tower is installed.



Elevated water tank

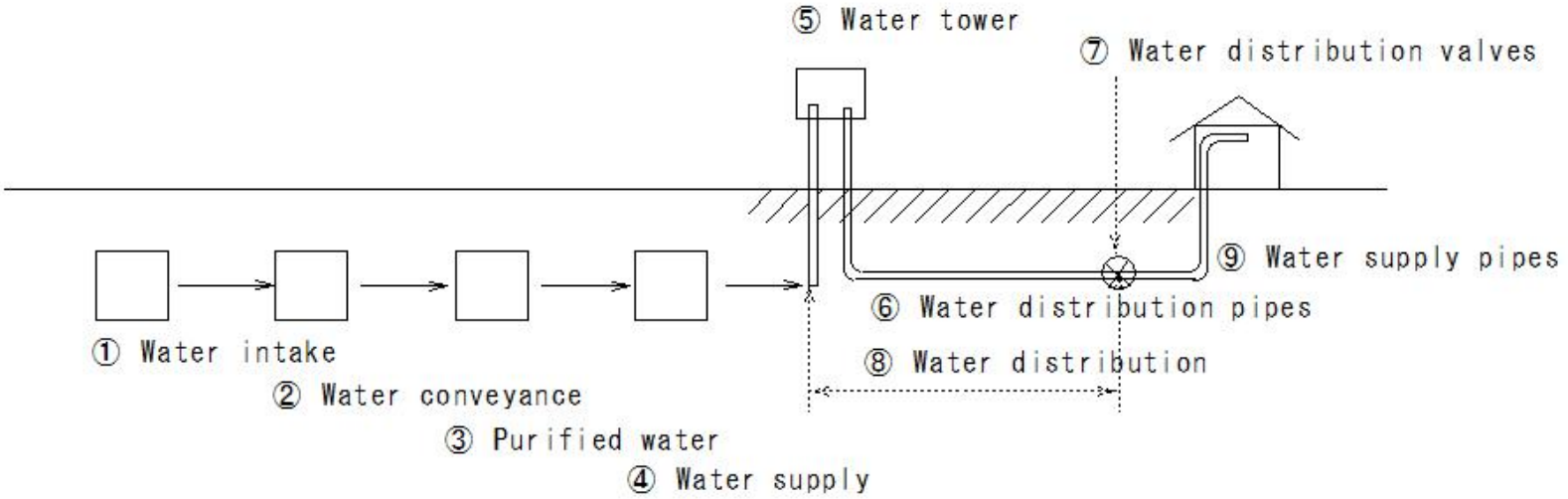
(W199)Water supply(Water Distribution)

(W199)Water supply(Water Distribution)

Water supply

Water Distribution

Reservoirs and towers: Sending water from pump stations to distribution areas



W5

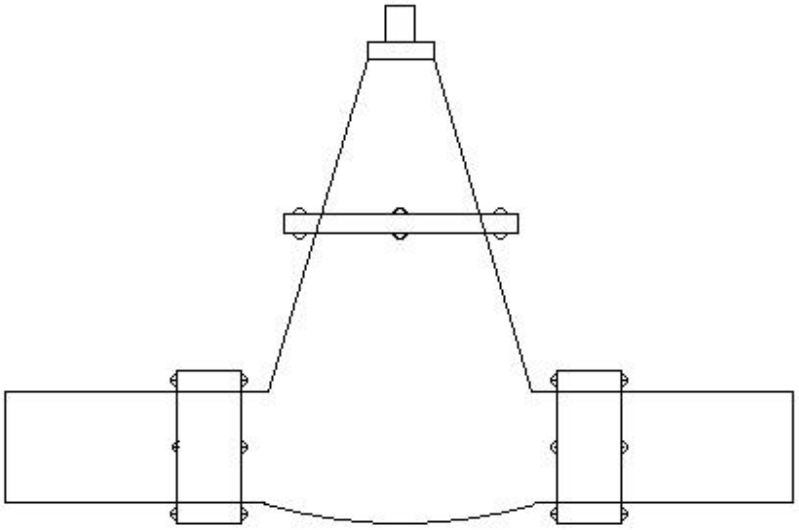
(W200)Water supply(Water control valve)

(W200)Water supply(Water control valve)

watersupply

Water control valve

- Adjusting or stopping the flow rate of water pipes
- Location of water distribution valves
- Downstream side of the fork of the drainage pipe, bridge attachment
- It will be installed downstream of the main branch point



Water control valve

(W201)Water supply and sewerage(Foundation work for water-conveyance (water pipes))

(W201)Water supply and sewerage(Foundation work for water-conveyance (water pipes))

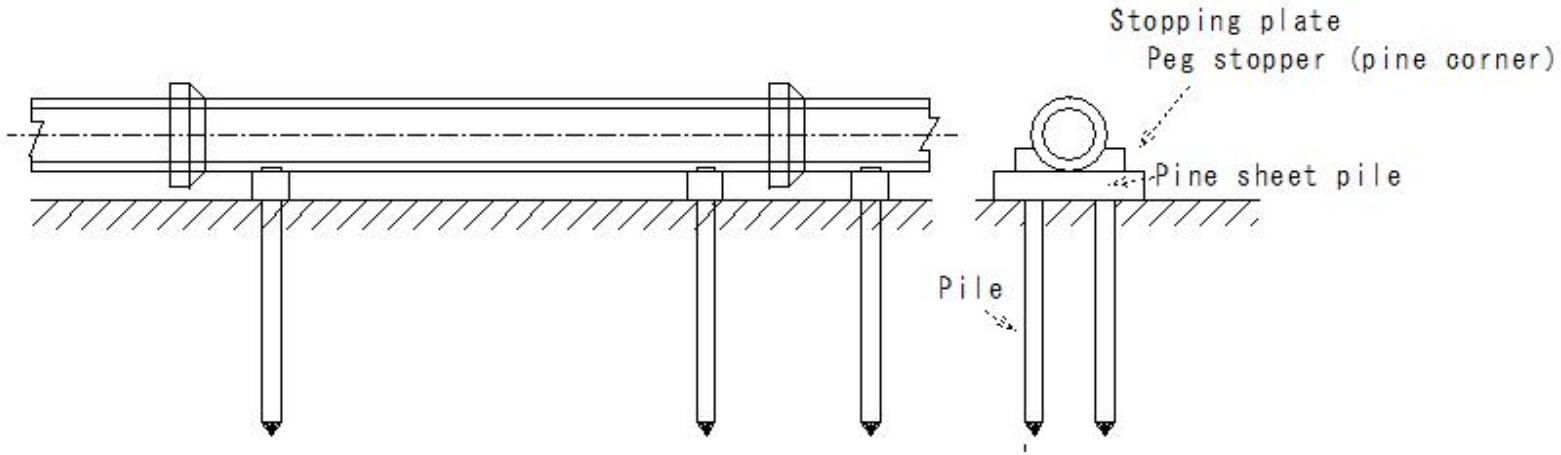
Water supply and sewerage

Substructure of water pipes

Foundation work for water-conveyance (water pipes)

・in case of the ground is normal - no foundation work is required.

・In the case of soft ground, use a front guard frame-shaped pile drive.



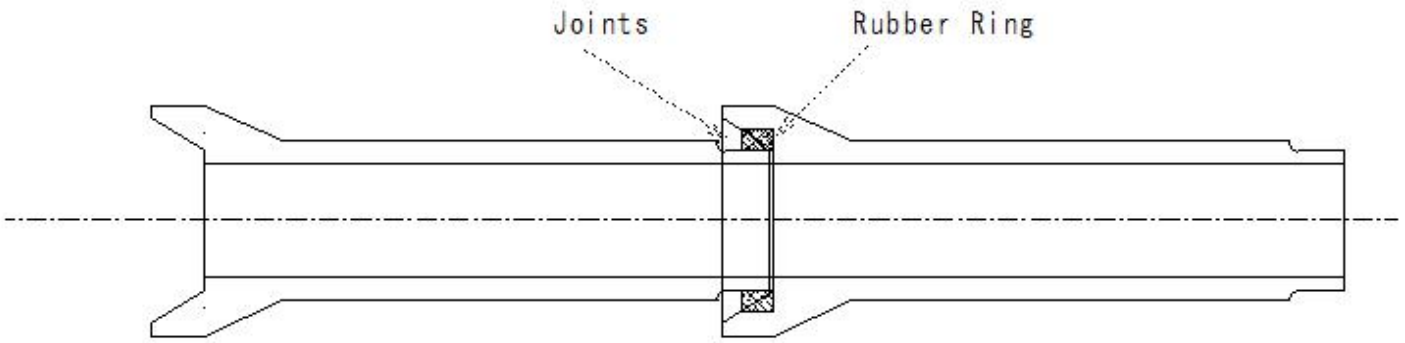
Foundation work for water-conveyance (water pipes)

W28

(W202)Sewerage(Socket joint)

(W202)Sewerage(Socket joint)

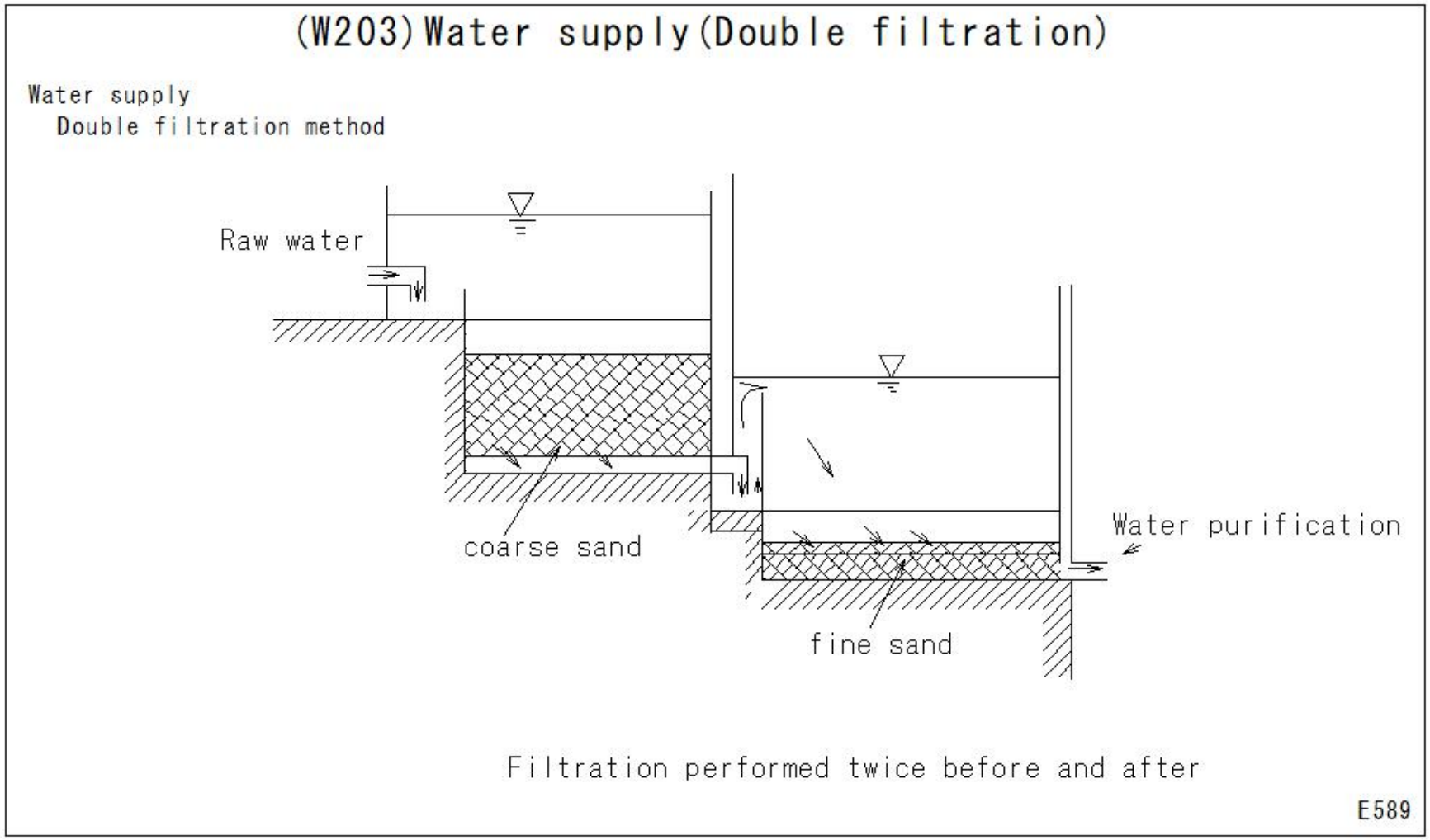
Sewerage
Socket joint



Socket joints

W95

(W203)Water supply(Double filtration)

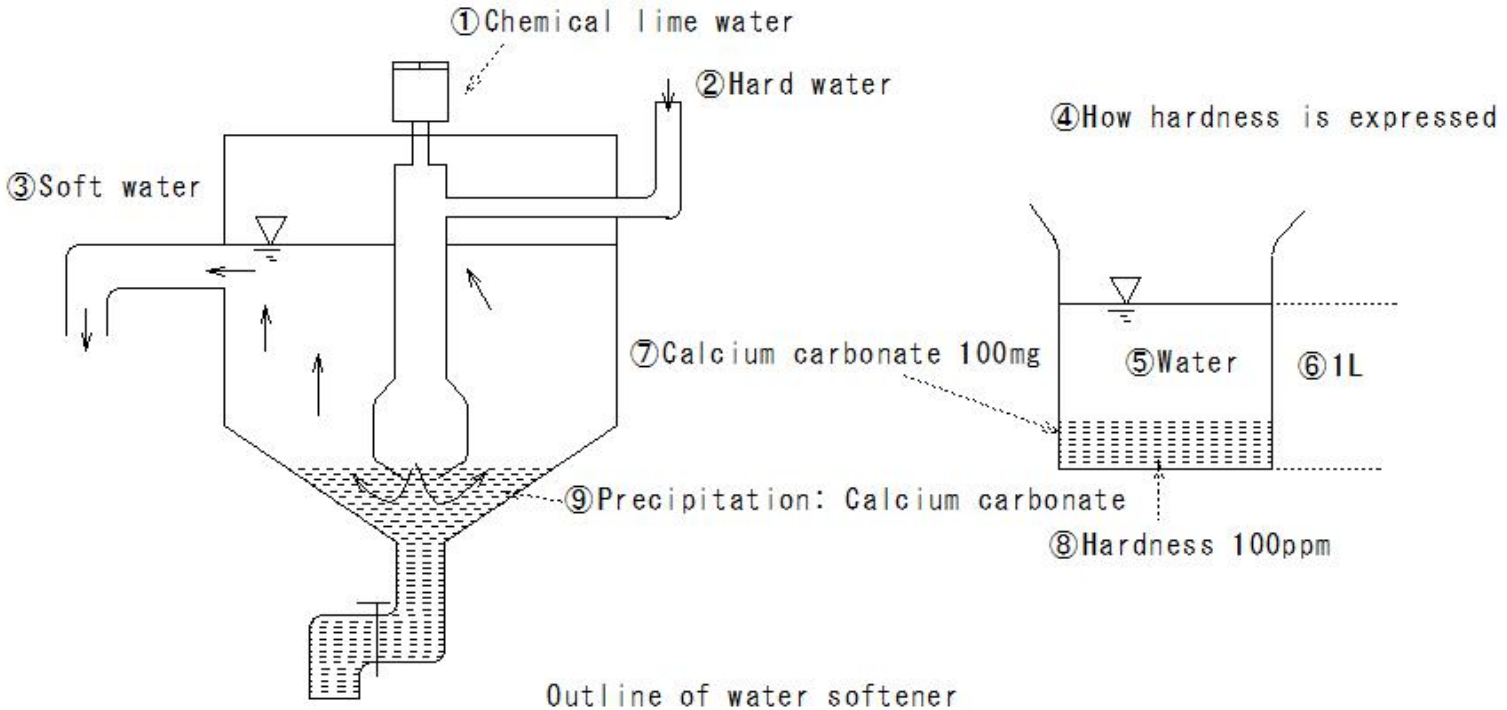


(W204)Water supply(Water softening)

(W204)Water supply(Water softening)

Water softening method

How to treat hard water to make it soft
Lowering water hardness
Soft water: calcium carbonate in water 100ppm or less



Outline of water softener

(W205)Water supply(trough)

(W205)Water supply(trough)

Water supply

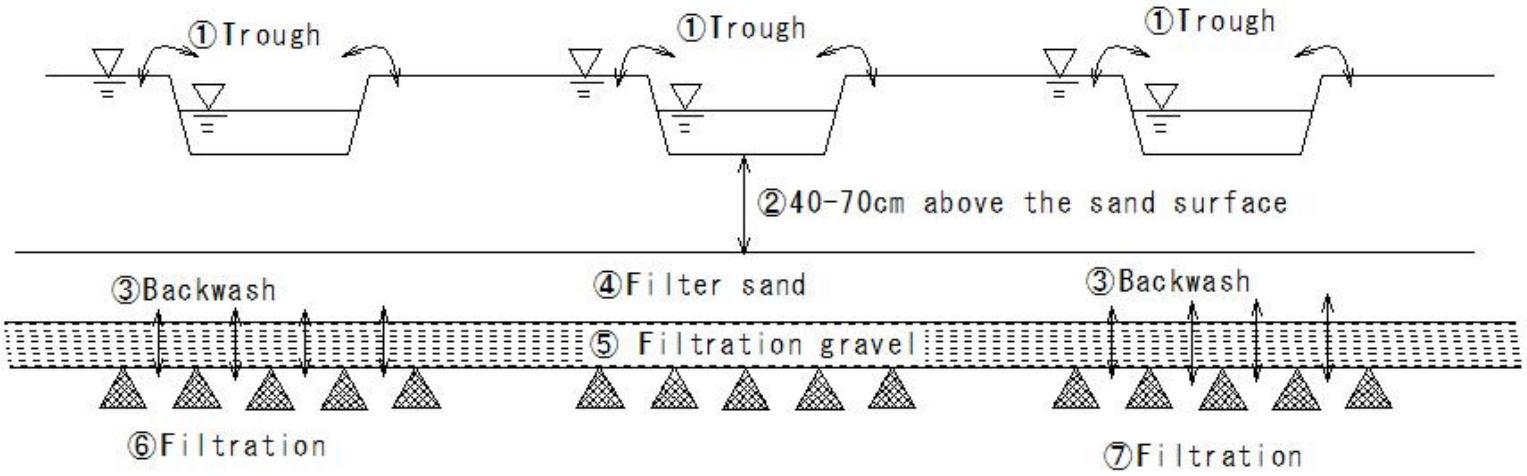
Trough

A groove-like facility installed on the filter sand of a rapid filtration basin

Characteristics

in case of raw water flows in and wash water flows out

The surface of the filter sand is not disturbed



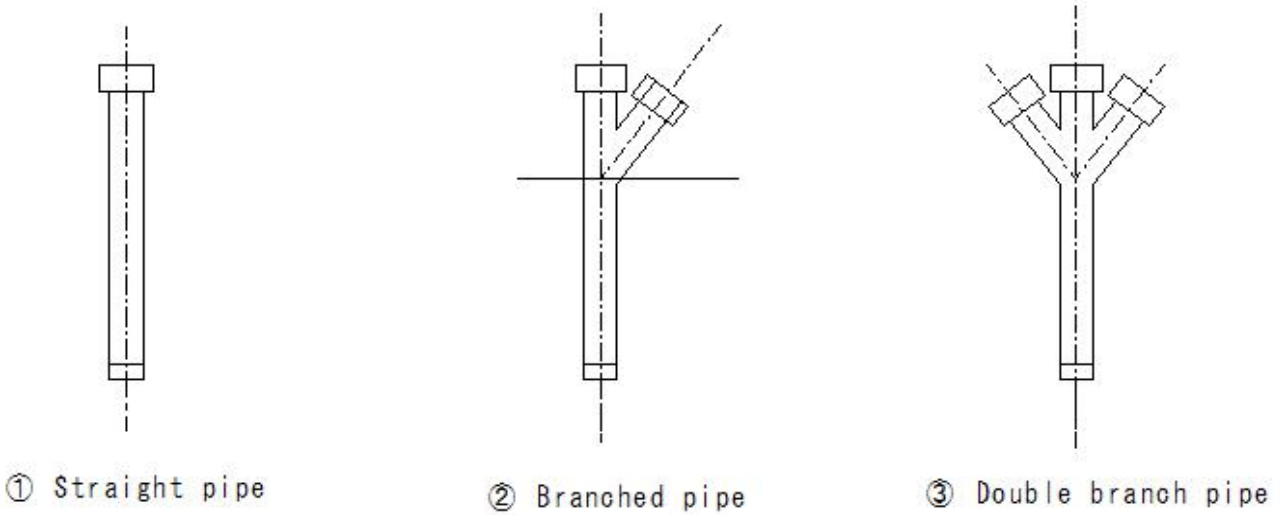
(W206)Water supply(earthenware pipe)

(W206)Water supply(earthenware pipe)

Water supply

earthenware pipe1(Ceramic pipe)

Clay - Extruder - After drying - Glaze - Firing



① Straight pipe

② Branched pipe

③ Double branch pipe

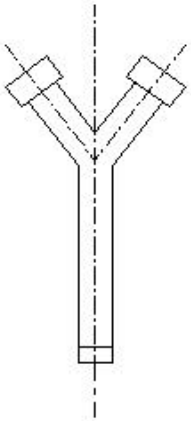
(W207)Water supply(earthenware pipe)

(W207)Water supply(earthenware pipe)

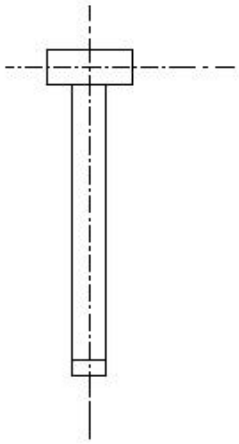
Water supply

earthenware pipe1(Ceramic pipe)

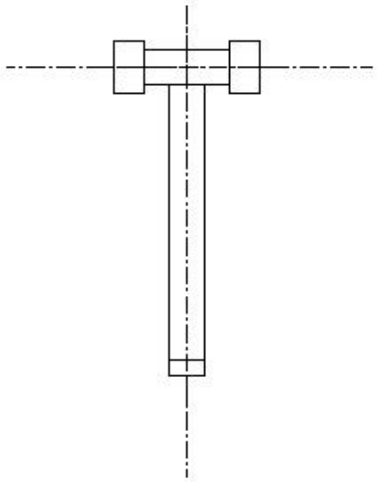
Clay - Extruder - After drying - Glaze - Firing



④ Y-shaped pipe



⑤ Reducing pipe



⑥ T-shaped pipe

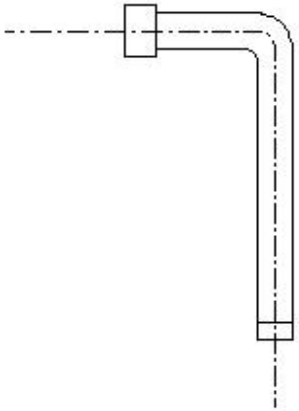
(W208)Water supply(earthenware pipe)

(W208)Water supply(earthenware pipe)

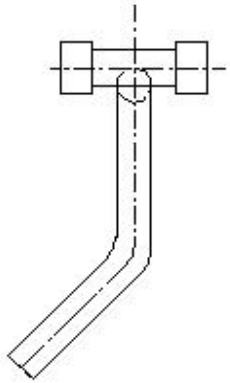
Water supply

earthenware pipe1(Ceramic pipe)

Clay - Extruder - After drying - Glaze - Firing



⑦ 90° bend



⑧ 45° bend

⑨ Grooved pipe

⑩ Semicircular pipe

(W209)Water supply and sewerage(Earth retaining works)

(W209)Water supply and sewerage(Earth retaining works)

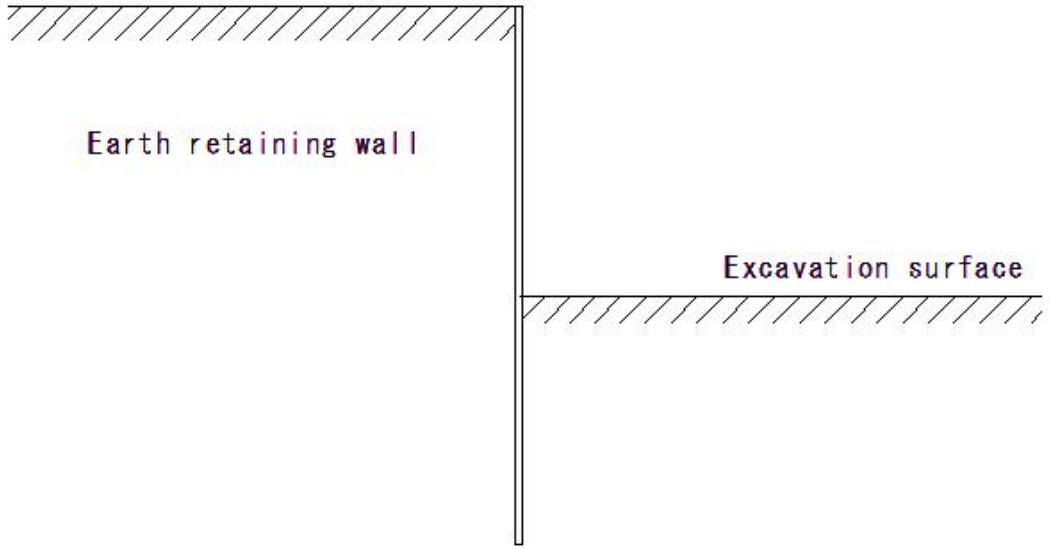
Water supply and sewerage

Earth retaining works

・Cut and cover method

・Prevention of excavation surface collapse

①Freestanding



①Freestanding

(W210)Water supply and sewerage(Earth retaining works)

(W210)Water supply and sewerage(Earth retaining works)

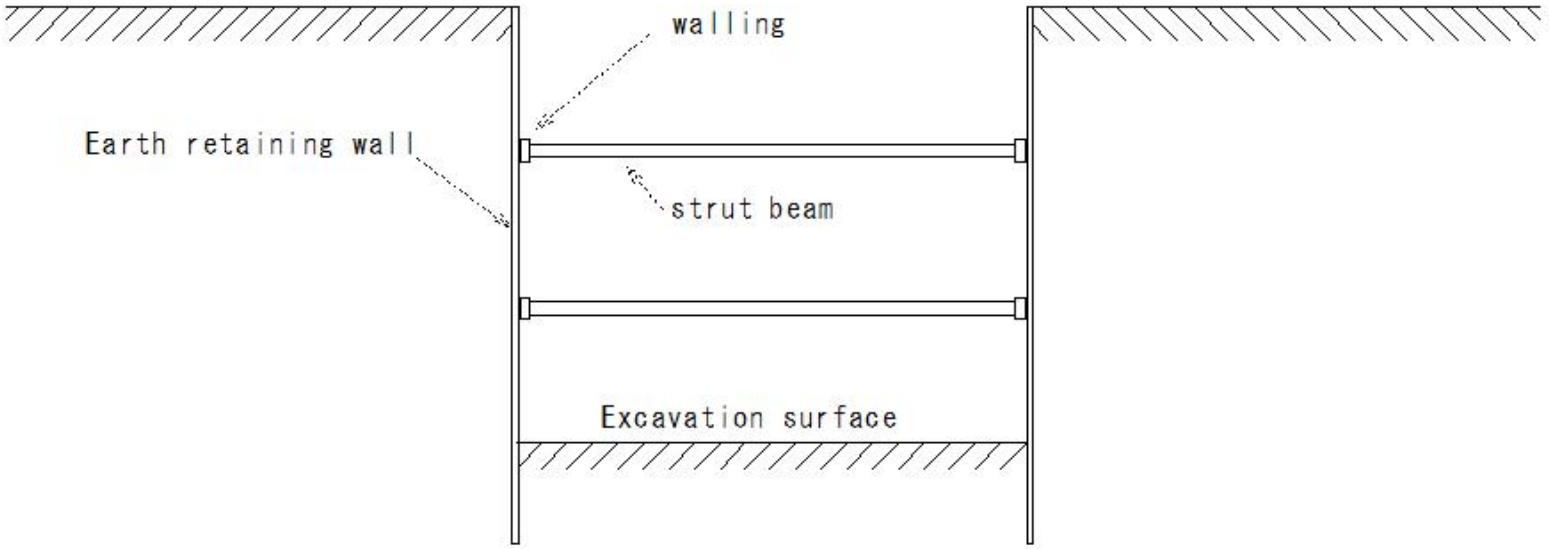
Water supply and sewerage

Earth retaining works

・Cut and cover method

・Prevention of excavation surface collapse

②strut beam type



(W211)Water supply and sewerage(Earth retaining works)

(W211)Water supply and sewerage(Earth retaining works)

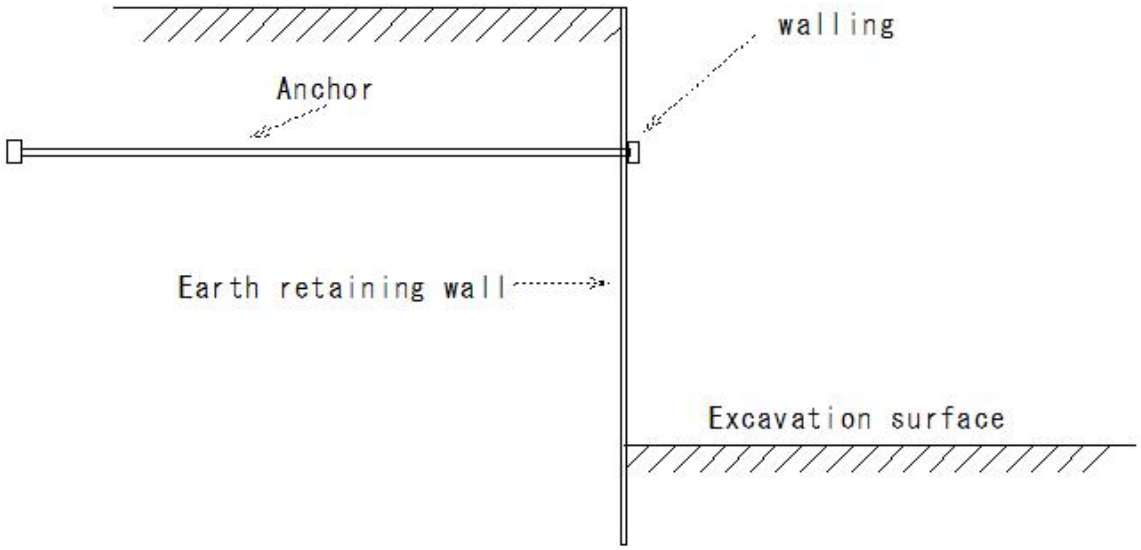
Water supply and sewerage

Earth retaining works

・Cut and cover method

・Prevention of excavation surface collapse

③Anchor type



③Anchor type

(W212)Water supply and sewerage(Earth retaining works)

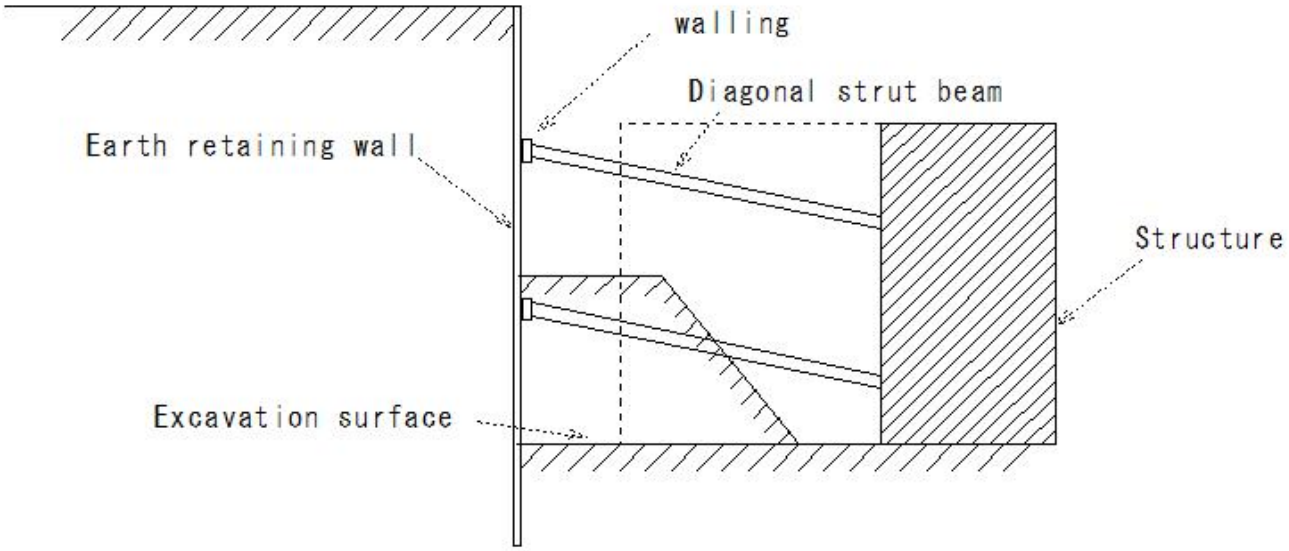
Water supply and sewerage

Earth retaining works

・Cut and cover method

・Prevention of excavation surface collapse

④Island type



④Island type

(W213)Water supply(Mud spit pipe)

(W213)Water supply(Mud spit pipe)

Waterworks

Mud Spit Pipe

house inlet

Water supply pipelines

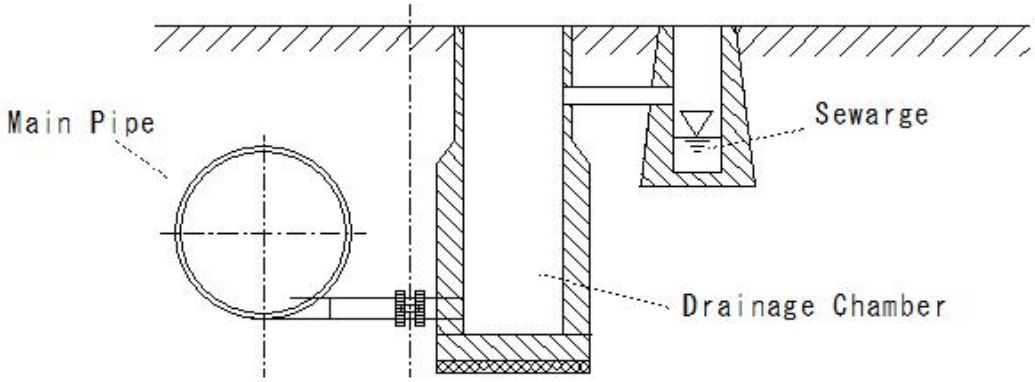
Recess in the pipeline

inverted siphon

Aqueduct

Bridge Annex

Install a Water Control Valve



Mud Discharge Valve

Connects to mains

Mud Spit Pipe

(W214)Water supply(Water Distribution Reservoir)

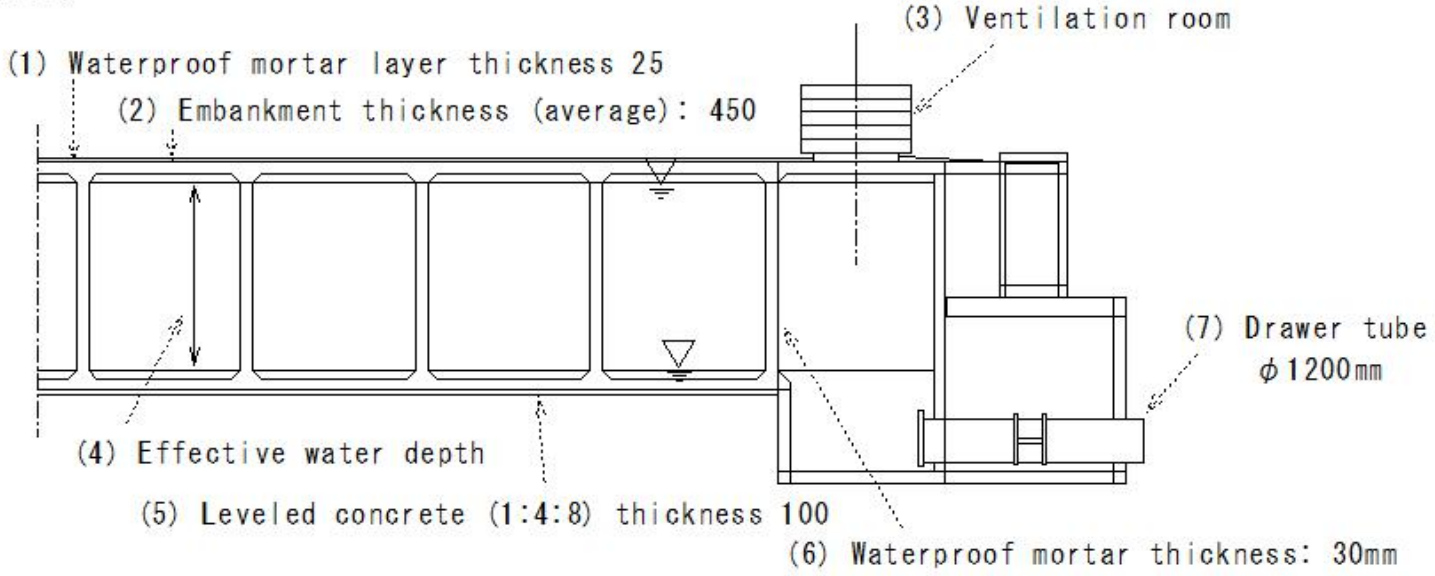
(W214)Water supply(Water Distribution Reservoir)

Water supply

Water Distribution Reservoir

Water purification - storage and distribution so that it can be distributed

- Center of water distribution area: High location
- Structure - Reinforced concrete, steel
- Install the lid



Example of a flat-slab structure water distribution reservoir

(W215)Water supply(Flange coupling)

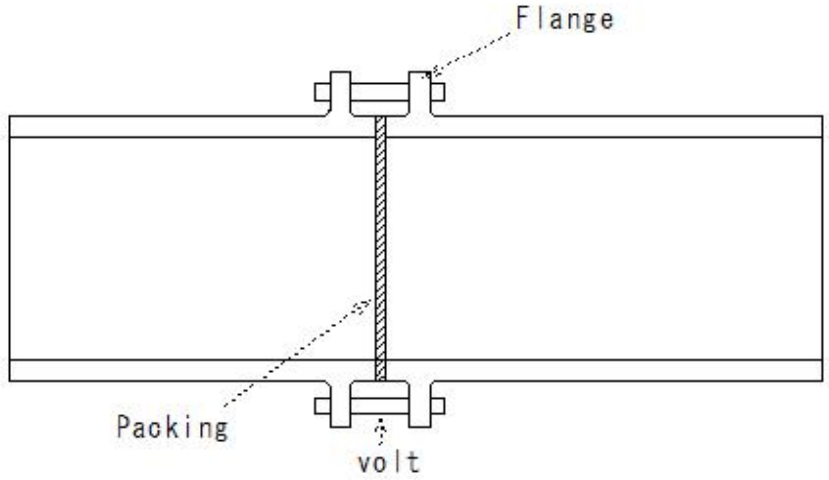
(W215)Water supply(Flange coupling)

Water supply

Flange coupling

A type of water pipe fitting

- The tube is subject to vibration.
- in case of a pipe that needs to be replaced
- No elasticity due to temperature differences
- Disadvantage that is vulnerable to deformation



Flange coupling

(W216)Water supply(Floc Formation Pond)

(W216)Water supply(Floc Formation Pond)

Water supply

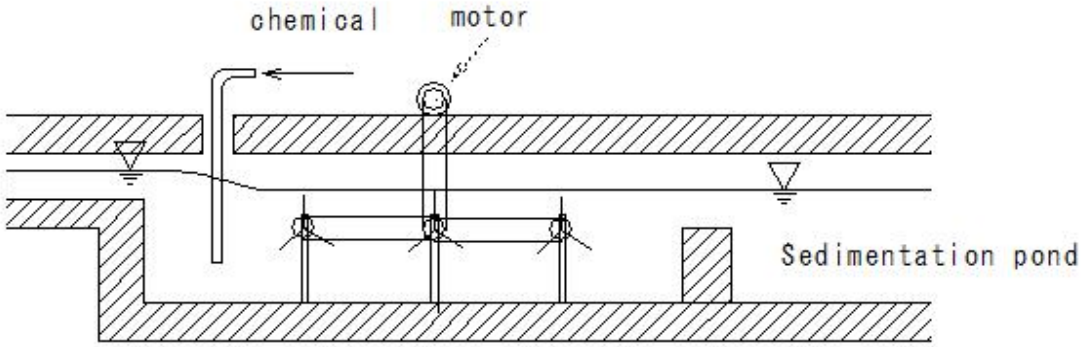
Floc Formation Pond

- Purification of raw water from water supply
- Floc Formation Pond
- Mixing chemicals into raw water
- Stir
- Contact with water and chemicals

Floating objects in water - flocs

Sent to the sedimentation pond

- Sediment removal



(W217)Water supply and sewerage(horizontal auger)

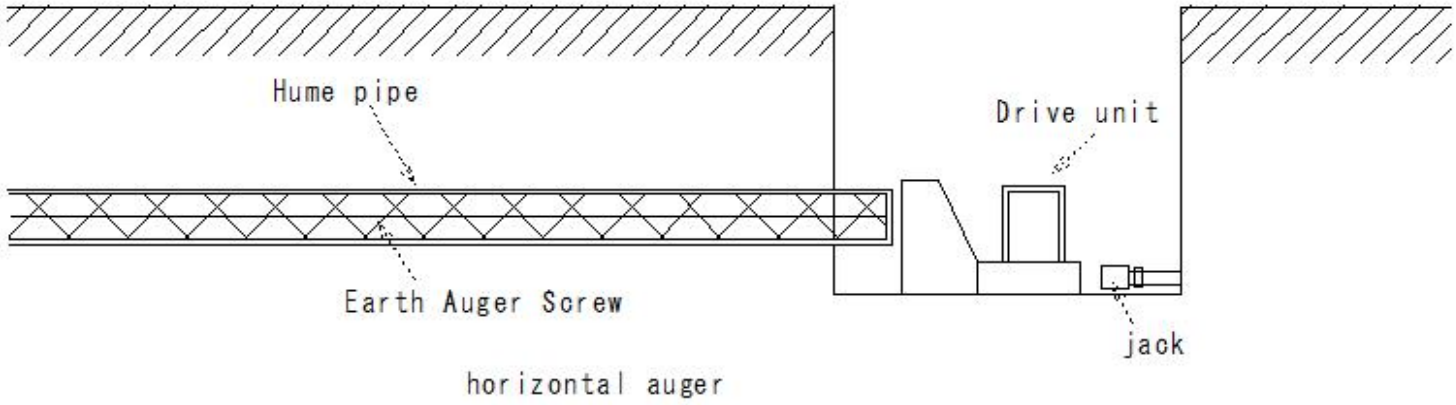
(W217)Water supply and sewerage(horizontal auger)

Water supply and sewerage

horizontal auger

・Relatively hard ground

Drilling a hole in the propulsion direction



horizontal auger

(W218)Sewerage(Manhole)

(W218) Sewerage (Manhole)

Sewerage

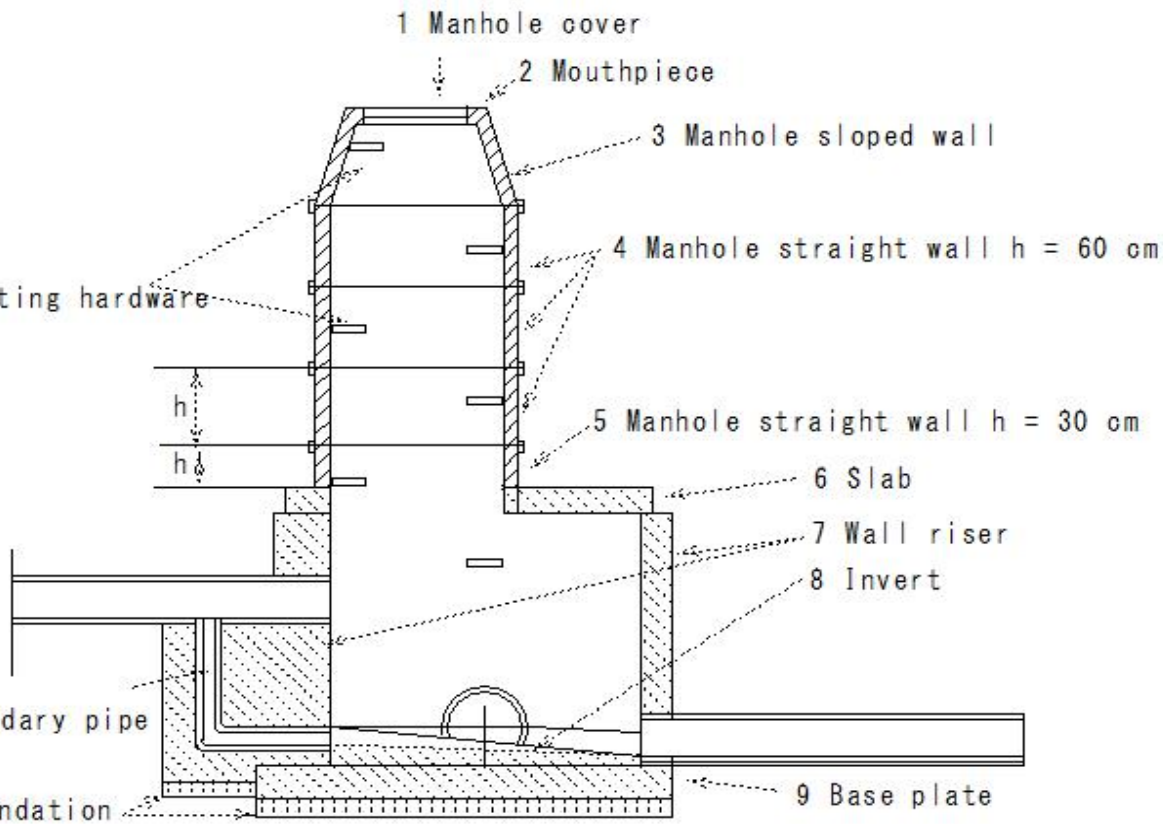
Manhole

Sewer pipe maintenance

Pipe cleaning and inspection

Installed at pipe joints

Pipe diameter (mm)	Maximum distance (m)
300 or less	50
600 or less	75
1000 or less	100
1500 or less	150
1650 or less	200



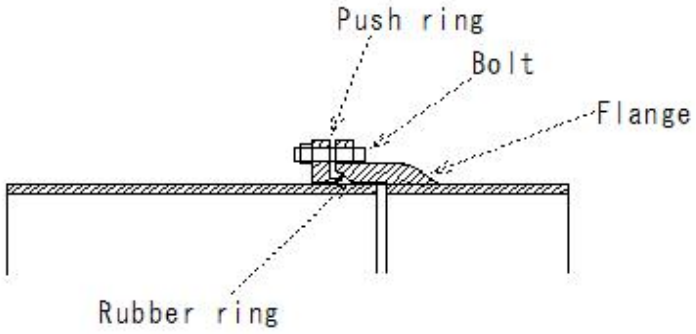
(W219)Water supply(Mechanical joint)

(W219)Water supply(Mechanical joint)

Water supply

Mechanical joint

A type of joint used in water supply systems to connect cast iron pipes



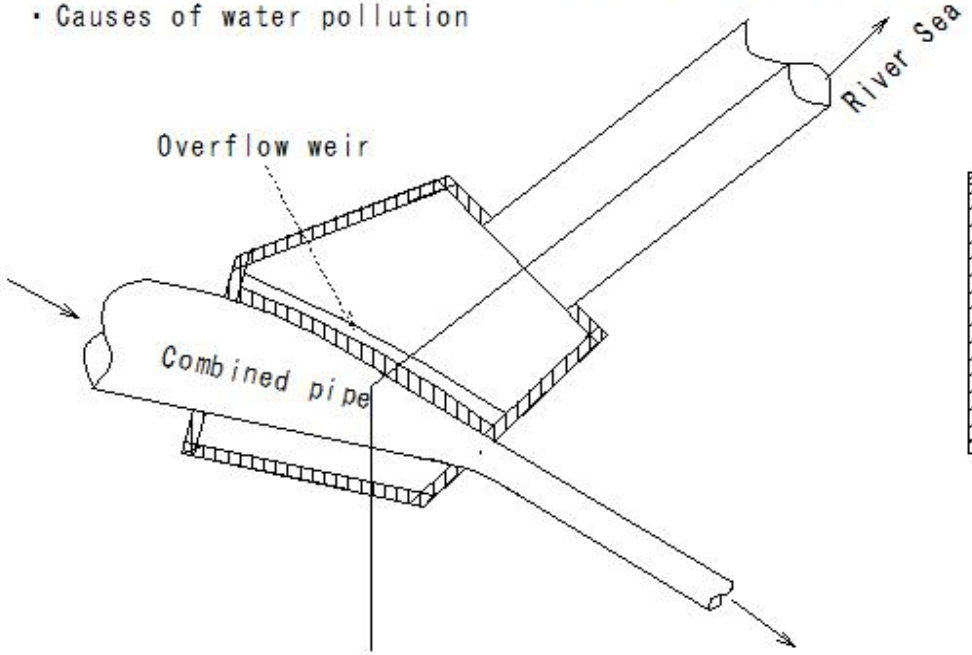
(W220)Sewerage(storm outfall(Rainwater outlet))

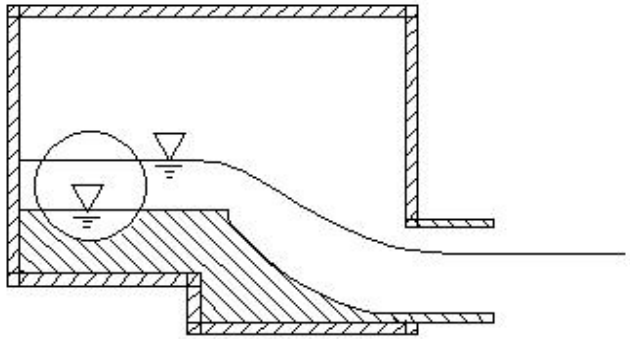
(W220)Sewerage(storm outfall(Rainwater outlet))

Sewerage

storm outfall(Rainwater outlet)

- Rainwater - Dirt is diluted
- Sewage volume - 2-3 times or more the amount of sewage
- Other sewage - Overflows the weir and is discharged into the river or sea
- Causes of water pollution





(W221)Sewerage(street inlet(Rainwater basin))

(W221)Sewerage(street inlet(Rainwater basin))

Sewerage

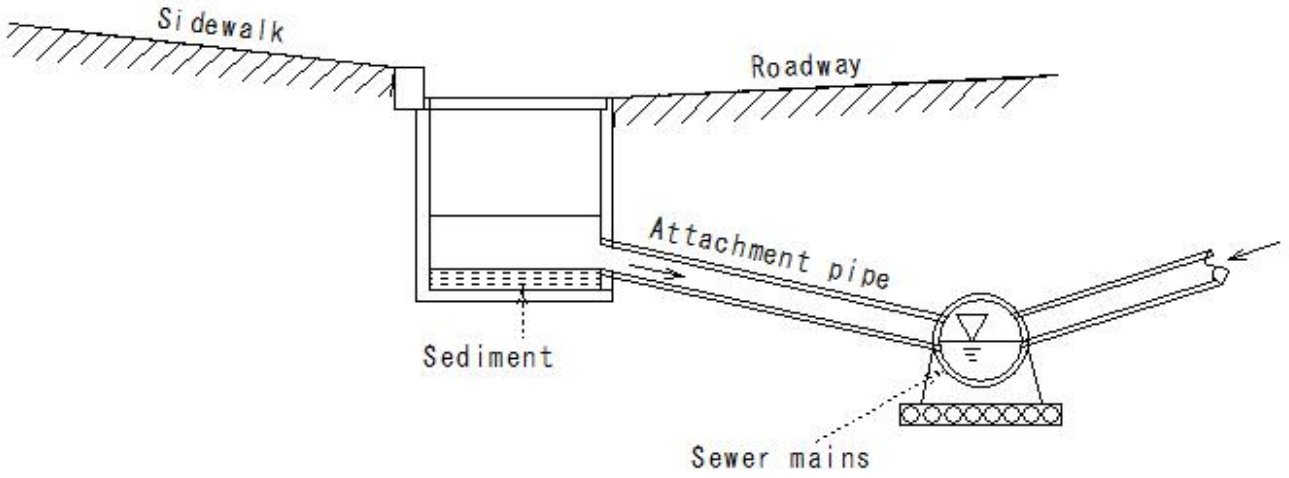
street inlet(Rainwater basin)

Every 30~50m.

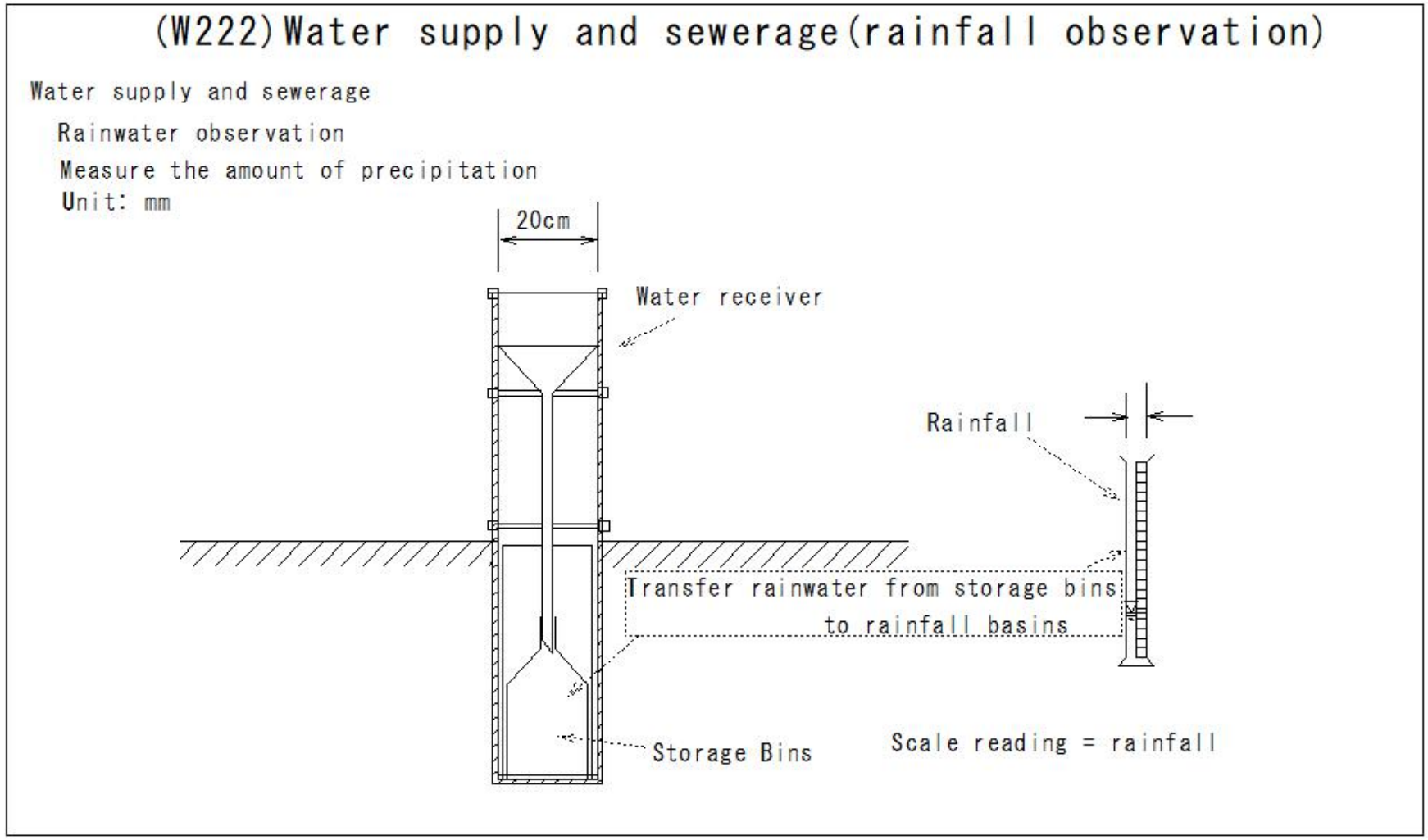
round, rectangular, concrete pit

Sediment at the bottom

Prevents sediment from flowing into sewer pipes



(W222)Water supply and sewerage(rainfall observation)



(W223)Water supply and sewerage(rain gauge)

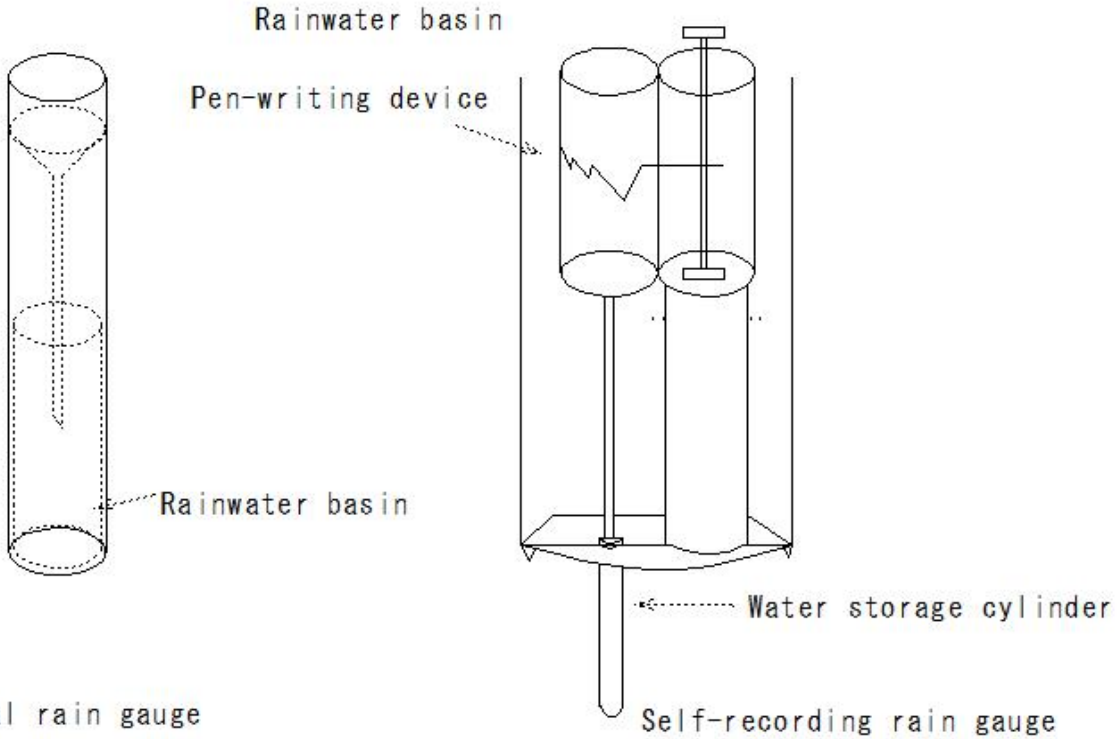
(W223)Water supply and sewerage(rain gauge)

Water supply and sewerage

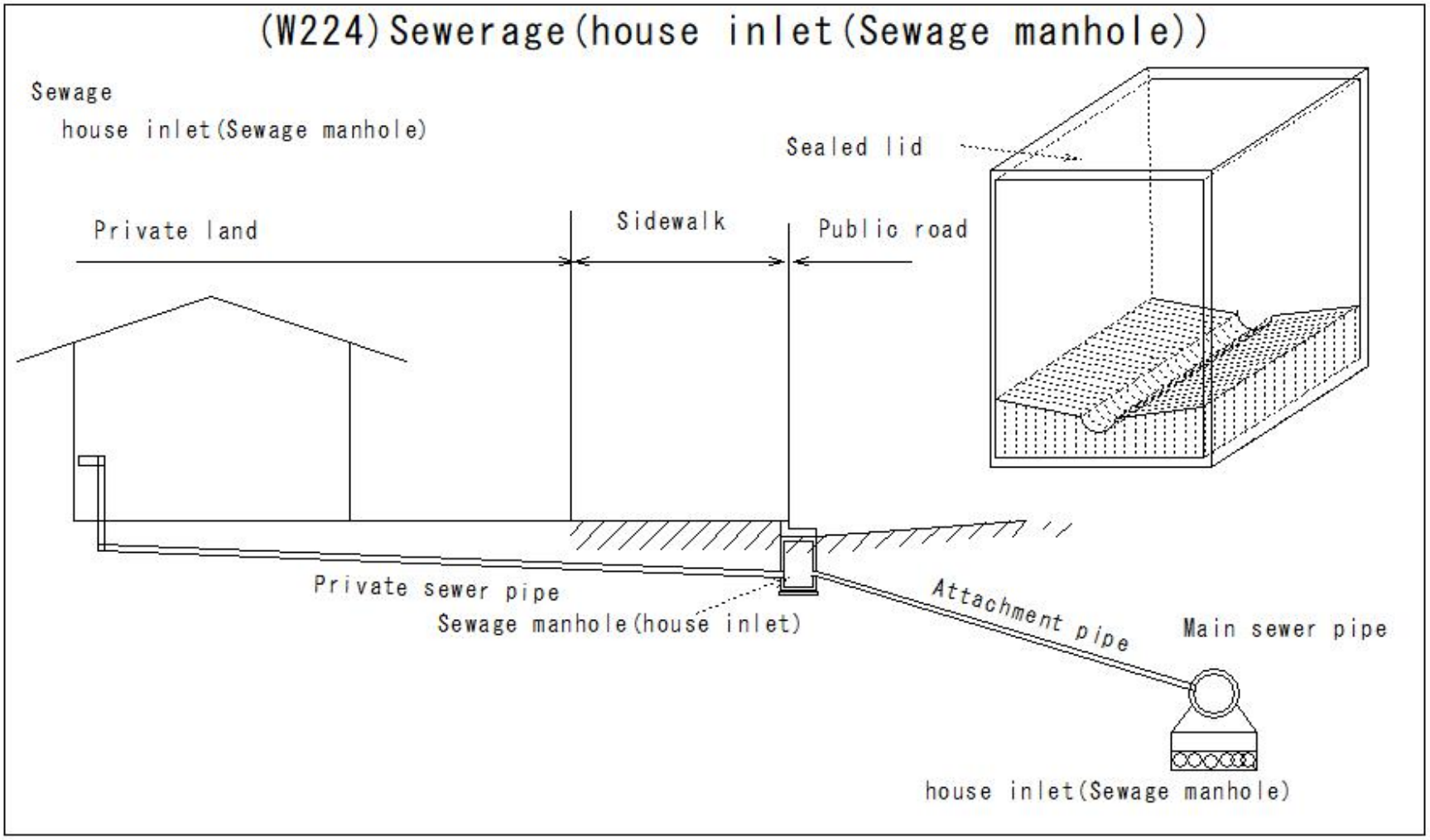
Rain gauge

Measures the amount of rainfall by the height of the rainwater in a rainwater basin

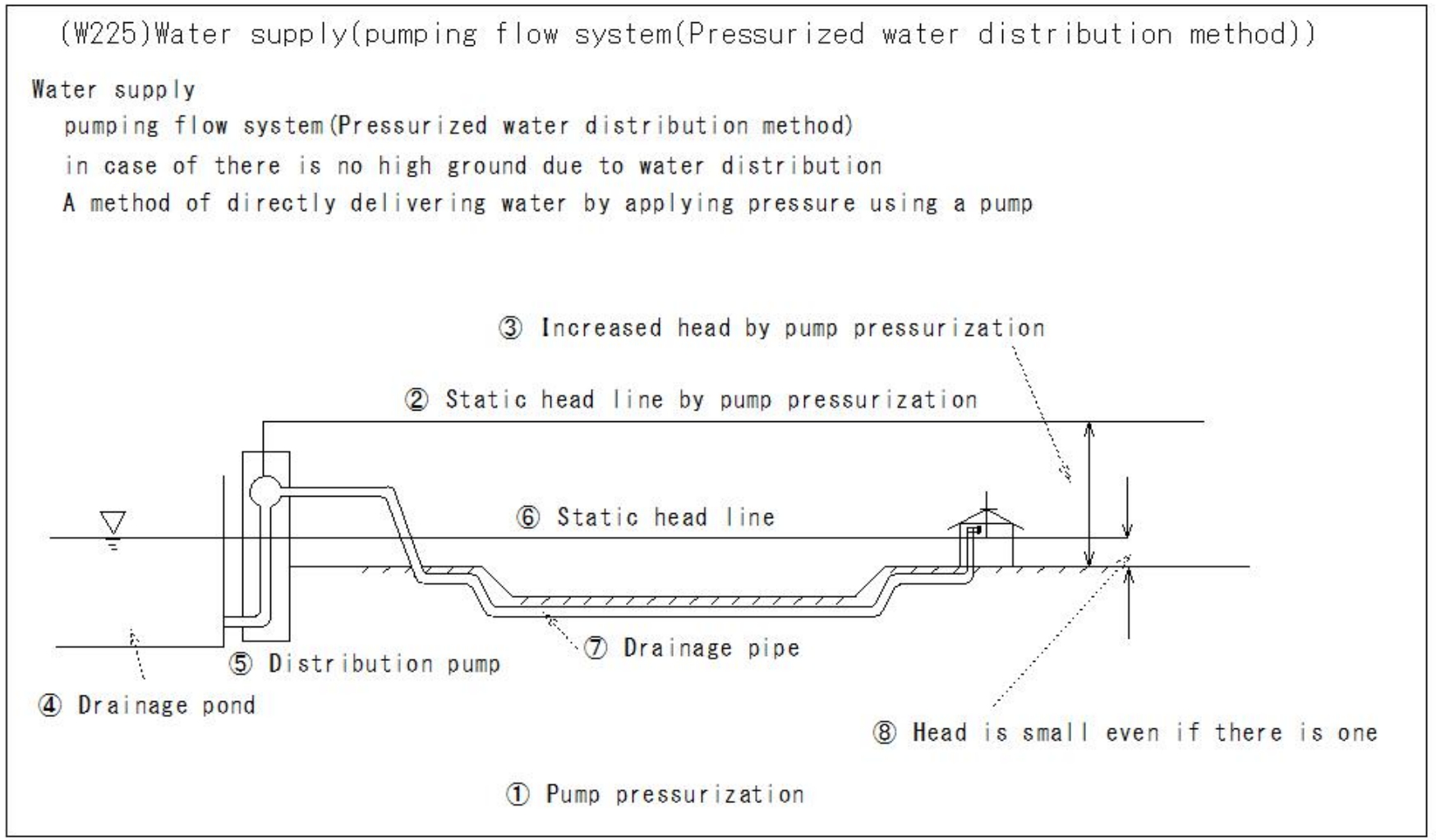
Normal rain gauge



(W224)Sewerage(house inlet(Sewage manhole))



(W225)Water supply(pumping flow system(Pressurized water distribution method))



(W226)Water supply(activated carbon method)

(W226)Water supply(activated carbon method)

Water supply

Activated carbon method

Water purification method for drinking water

Odor

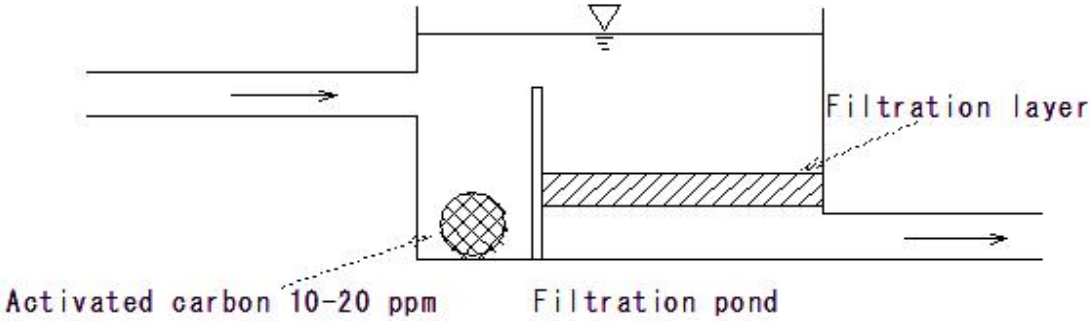
Color

Synthetic detergent

Removing radioactive substances

Uses activated carbon

Combined with ozone treatment



Temporary treatment

W229

(W227)Water supply(Rapid filtration)

(W227)Water supply(Rapid filtration)

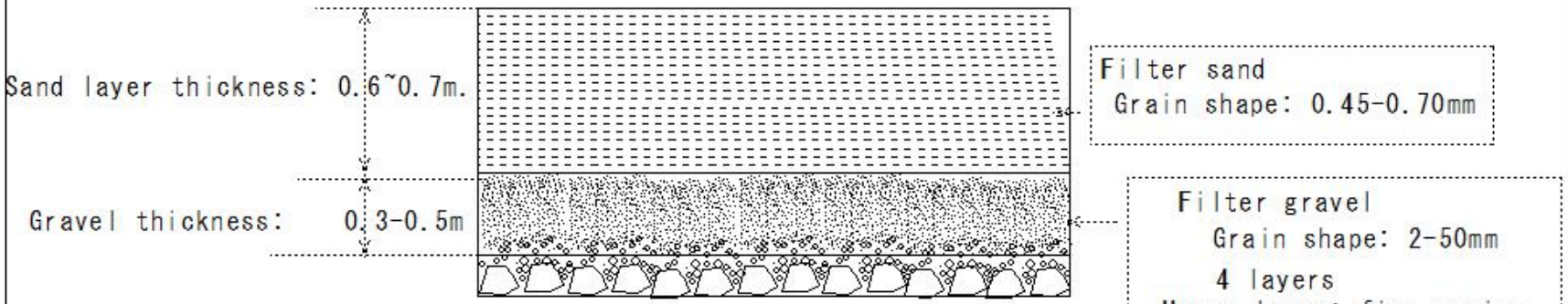
Water supply

Rapid filtration

Chemical coagulation precipitated water

Rapid filtration

- The area of the water purification plant - less is required
- Suitable for cold regions
- High maintenance and management costs



Cross-section of filter layer

(W228)Water supply(coagulation basin)

(W228)Water supply(coagulation basin)

Water supply

coagulation basin

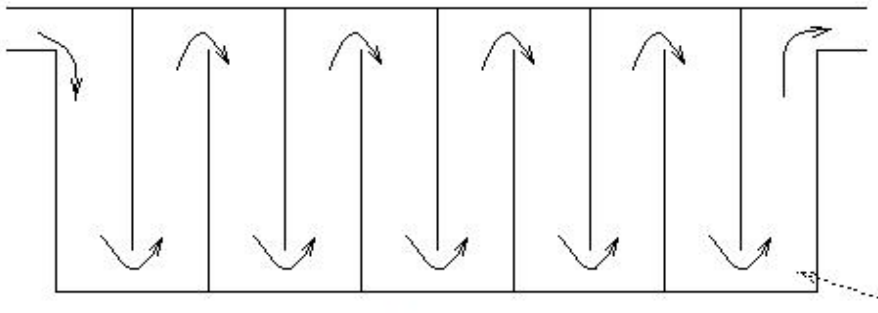
Water supply filtration process

・Add sulfuric acid soil to sulfuric acid

Admixture ponds → agglomerated sedimentation ponds

for agglomeration of suspended materials in raw water

vertical-flow



Chemicals and raw water are stirred to make blocks

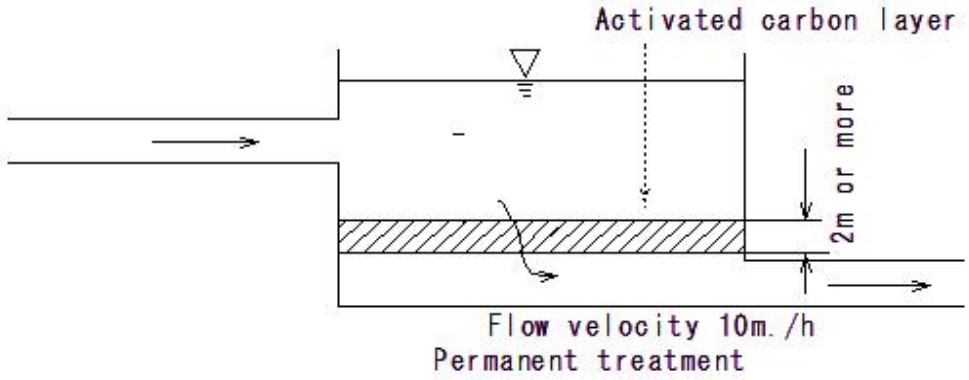
coagulation basin

(W229)Water supply(activated carbon method)

(W229)Water supply(activated carbon method)

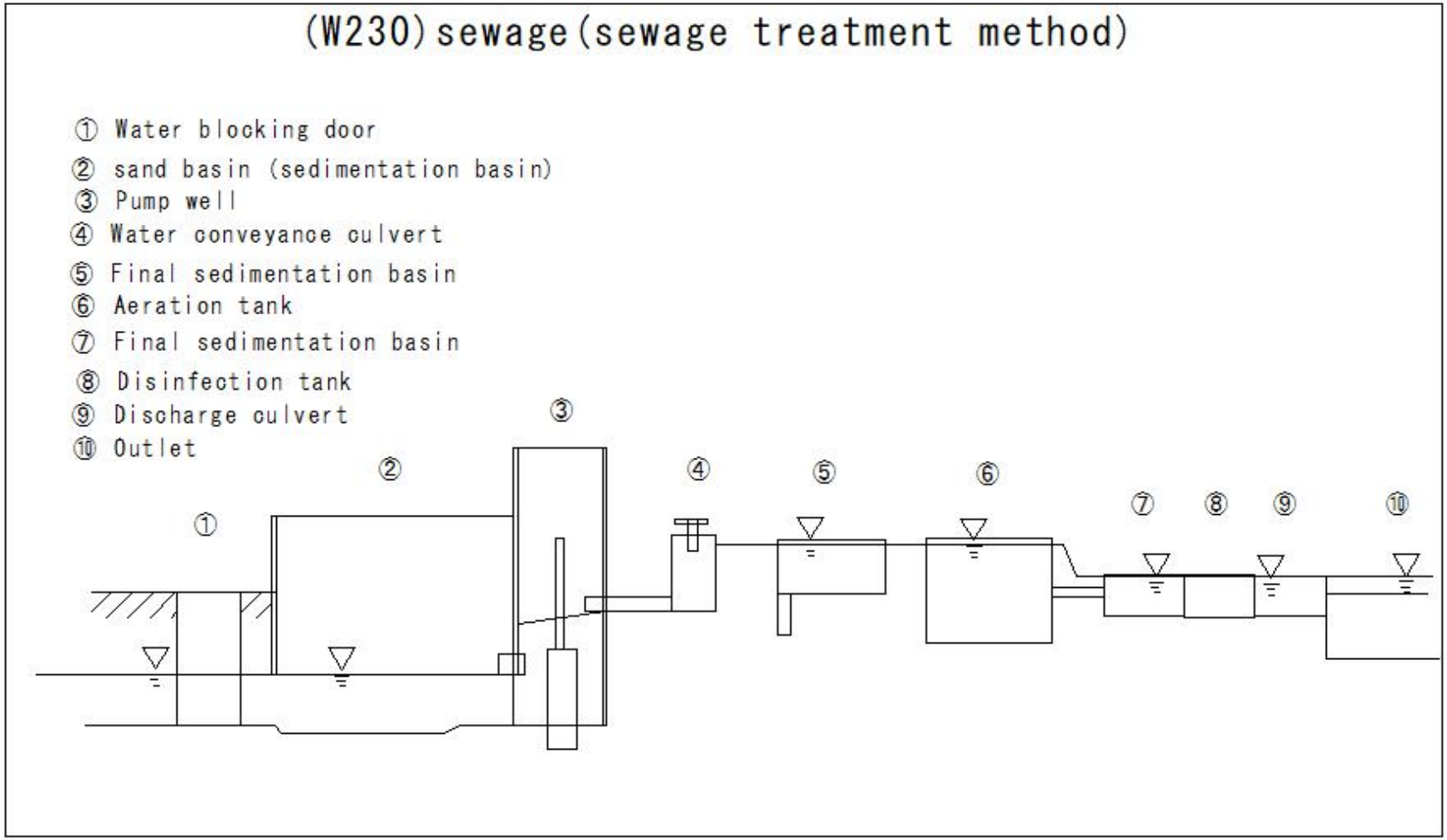
Water supply

- Activated carbon method
- Water purification method for drinking water
- Odor
- Color
- Synthetic detergent
- Removing radioactive substances
- Uses activated carbon
- Combined with ozone treatment

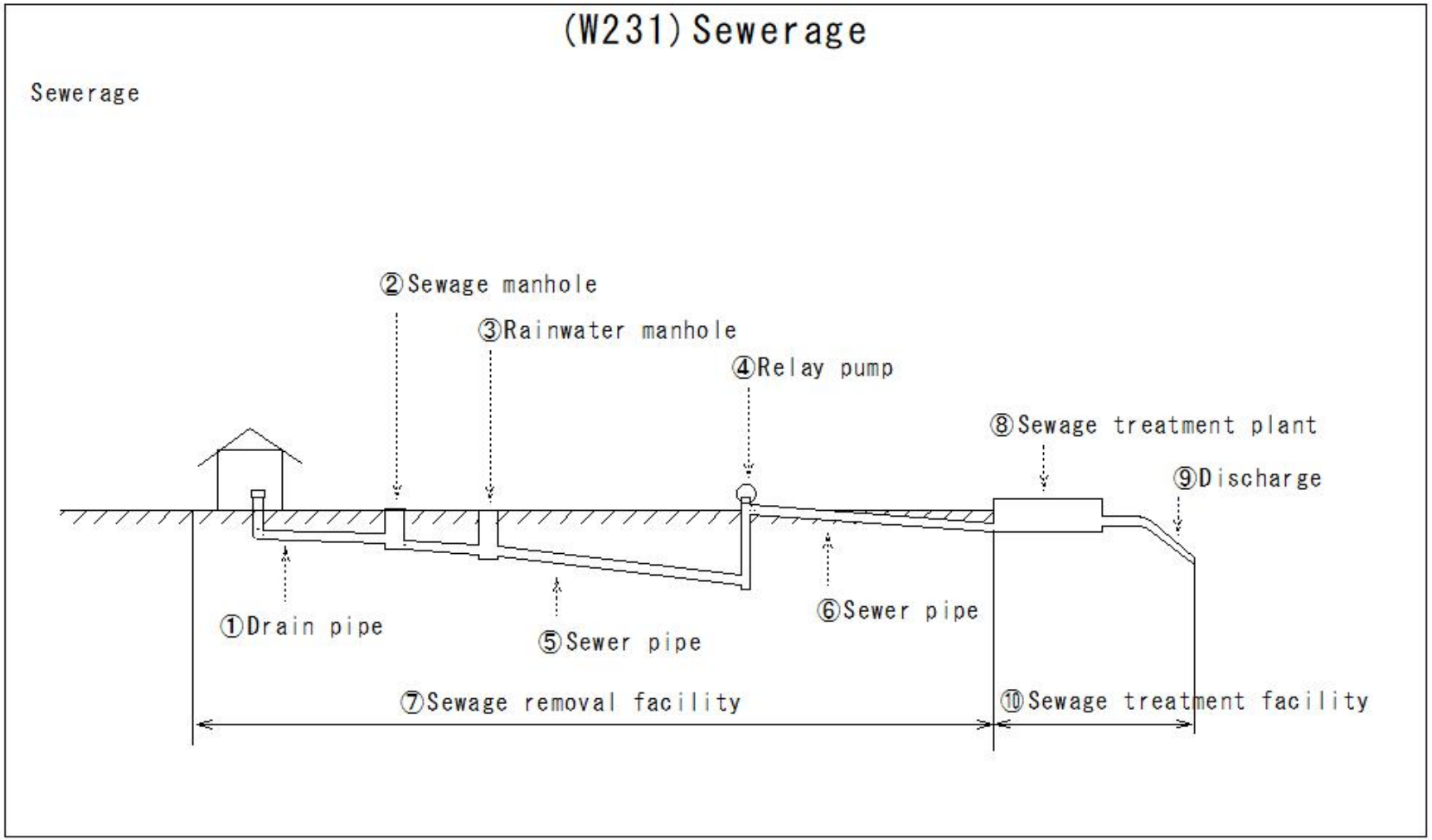


W226

(W230)sewage(sewage treatment method)



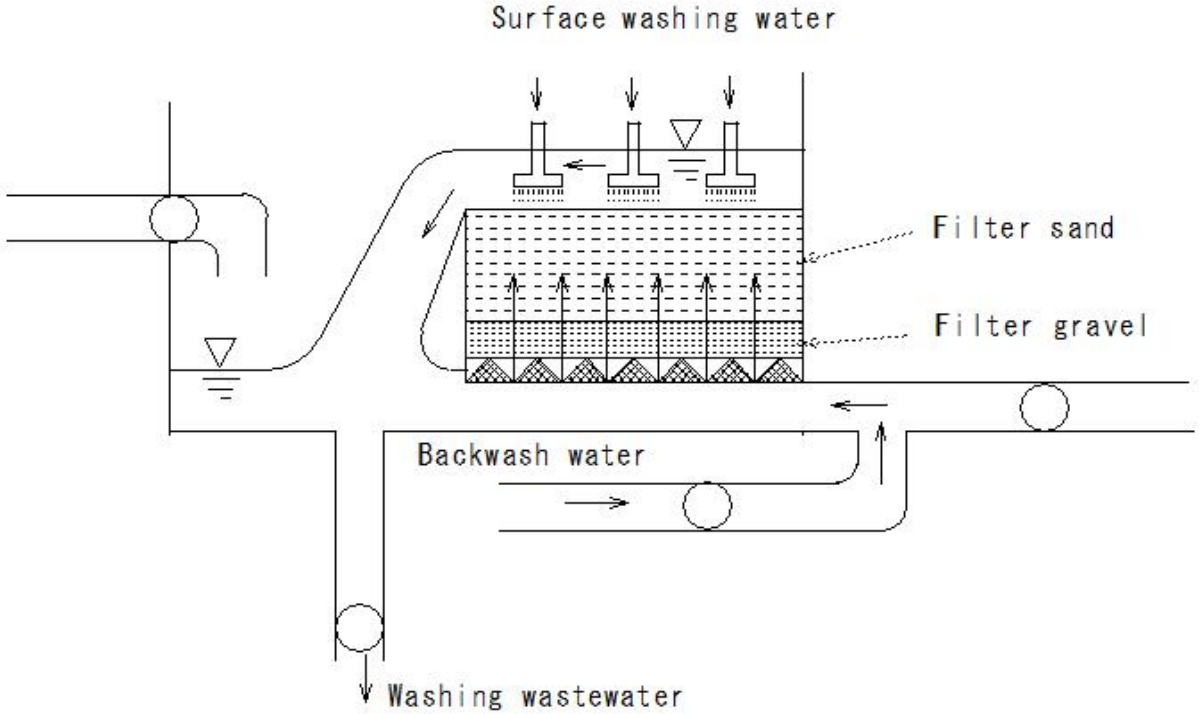
(W231)Sewerage



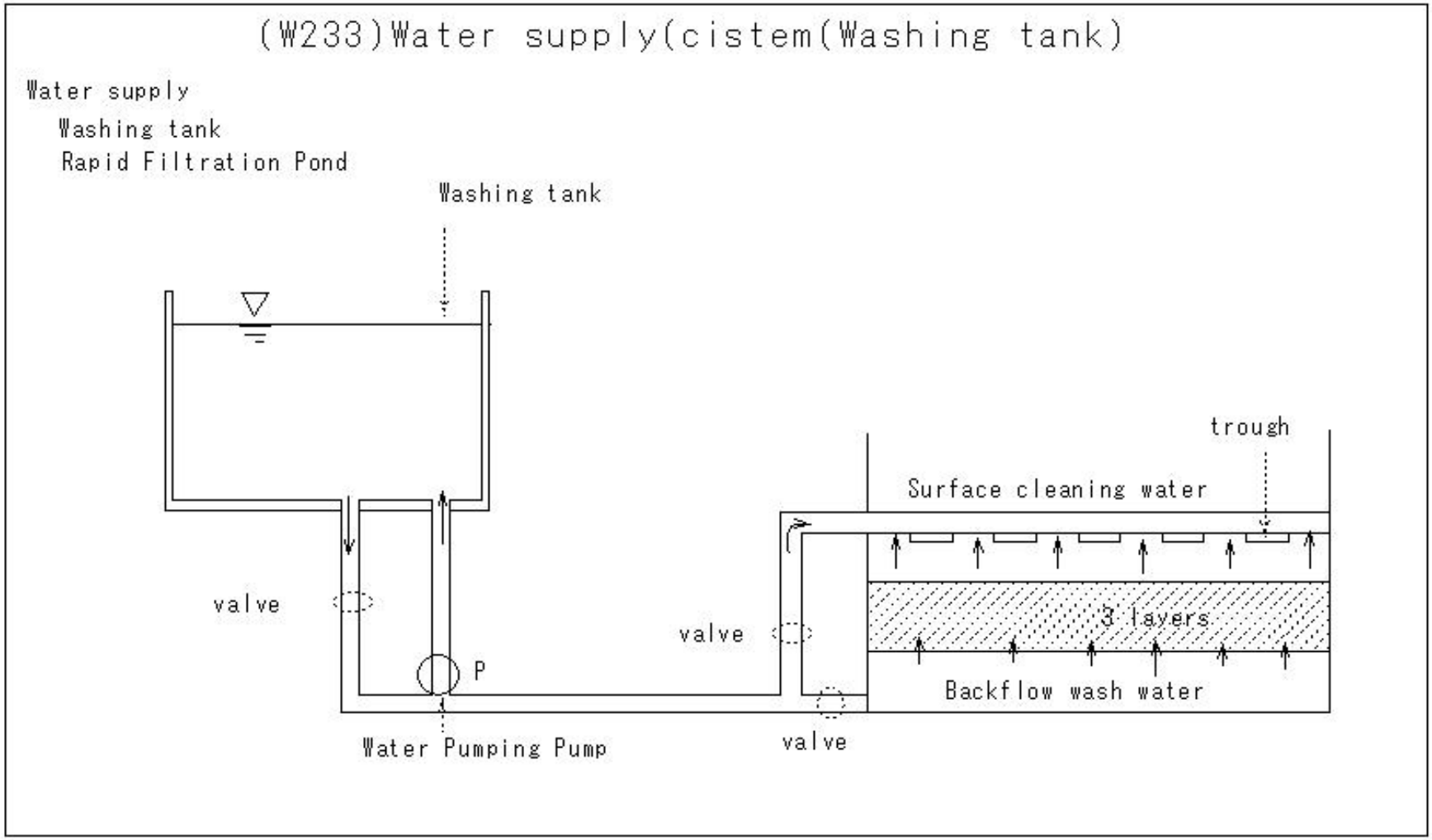
(W232)Water supply(back washing)

(W232)Water supply(back washing)

Water supply
back washing
Rapid filtration pond



(W233)Water supply(Washing tank)



(W234)Water supply(Elevated tank)

(W234)Water supply(Elevated tank)

Water supply

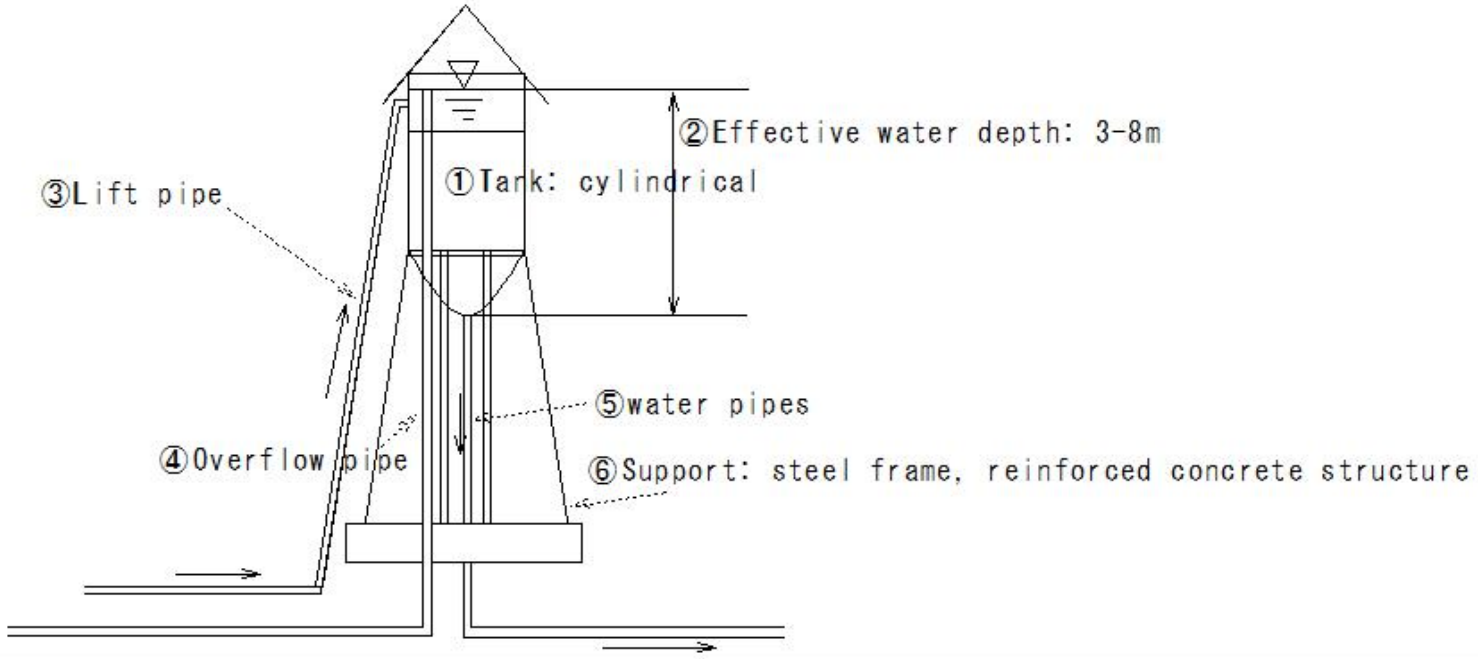
Elevated tank

Residential complexes

Small-scale water distribution area - drainage pond - when high places are not available

A water tank (tank) with an artificially high water level is provided with a pump,

Water supply facilities with natural water pressure



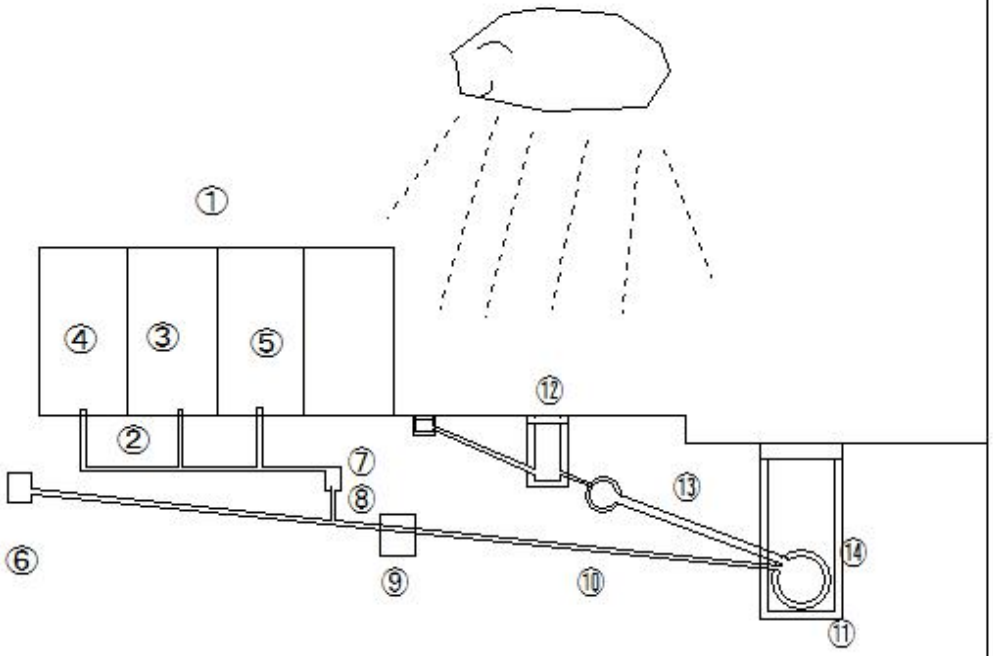
(W235)Sewerage(combined system)

(W235)Sewerage(combined system)

Sewerage

Combined type

① Residential land
② Drain pipe
③ Bathroom
④ Toilet
⑤ Kitchen
⑥ Sewage manhole
⑦ Sewage manhole
⑧ Drain pipe
⑨ Public sewage manhole
⑩ Sewage attachment pipe
⑪ Manhole
⑫ Public storm water manhole
⑬ Storm water attachment pipe
⑭ Sewer pipe

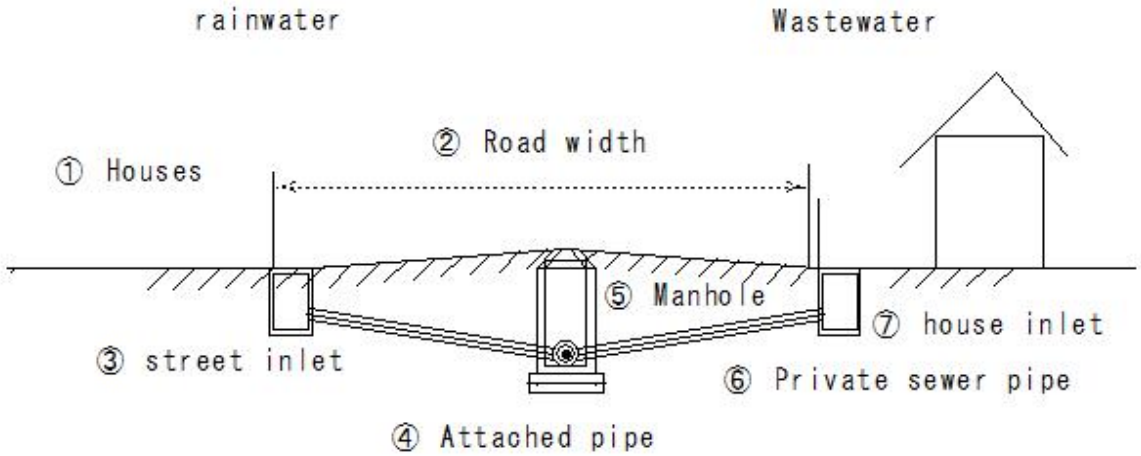


(W236)Sewerage(sewerage of combined system)

(W236)Sewerage(sewerage of combined system)

sewerage of combined system

Wastewater and rainwater are discharged into the same pipe
Combined sewer system; wastewater - untreated - discharge
Separate sewer system - water pollution prevention



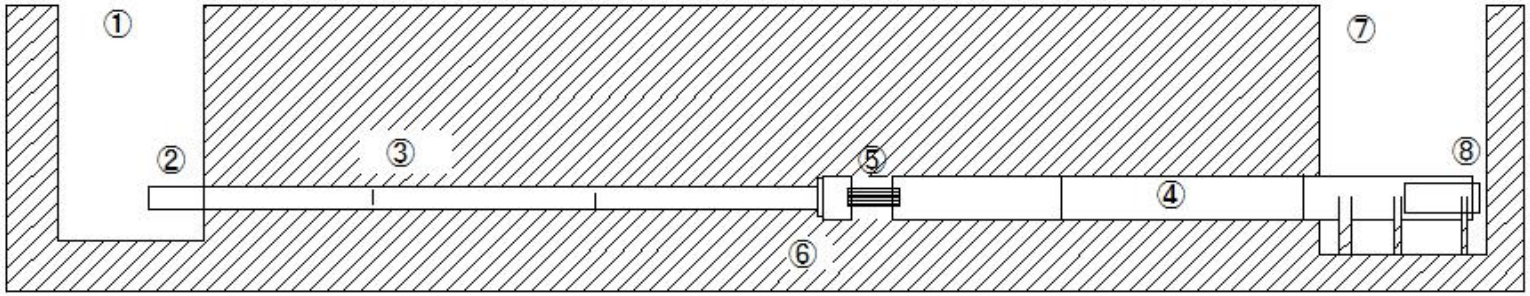
sewerage of combined system

(W237)Water supply and sewerage(mini size pipe jacking)

(W237)Water supply and sewerage(mini size pipe jacking)

Water supply and sewerage
mini size pipe jacking
Diameter: 700mm or less
Press in small-diameter pipe with hydraulic jack
Excavate and remove soil with machine to lay pipe

① Arrival pile
② Recovery
③ Pilot pipe
④ Jacking pipe (Hume pipe)
⑤ Consolidation
⑥ Consolidation head
⑦ Starting pile
⑧ Jack



(W238)Sewerage(air blow system)

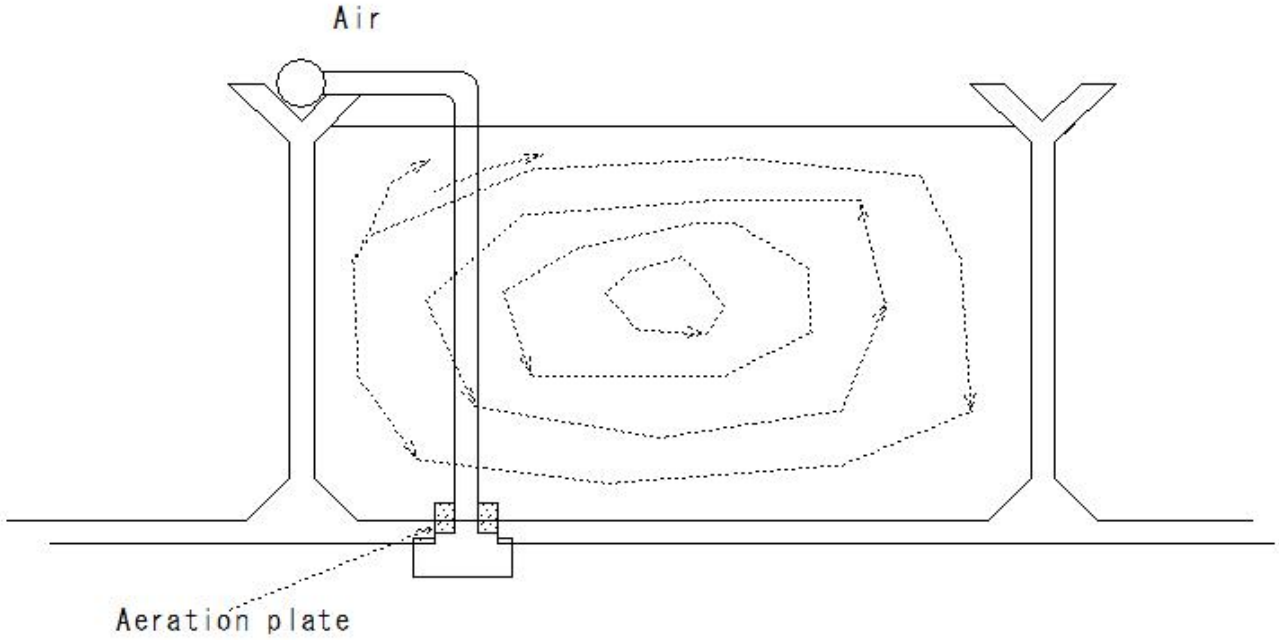
(W238)Sewerage(air blow system)

Sewerage

air blow system

Activated sludge treatment method for sewage

Method of blowing air into sewage



(W239)Sewerage(trickling filtration bed system)

(W239)Sewerage(trickling filtration bed system)

Sewerage

trickling filtration bed system

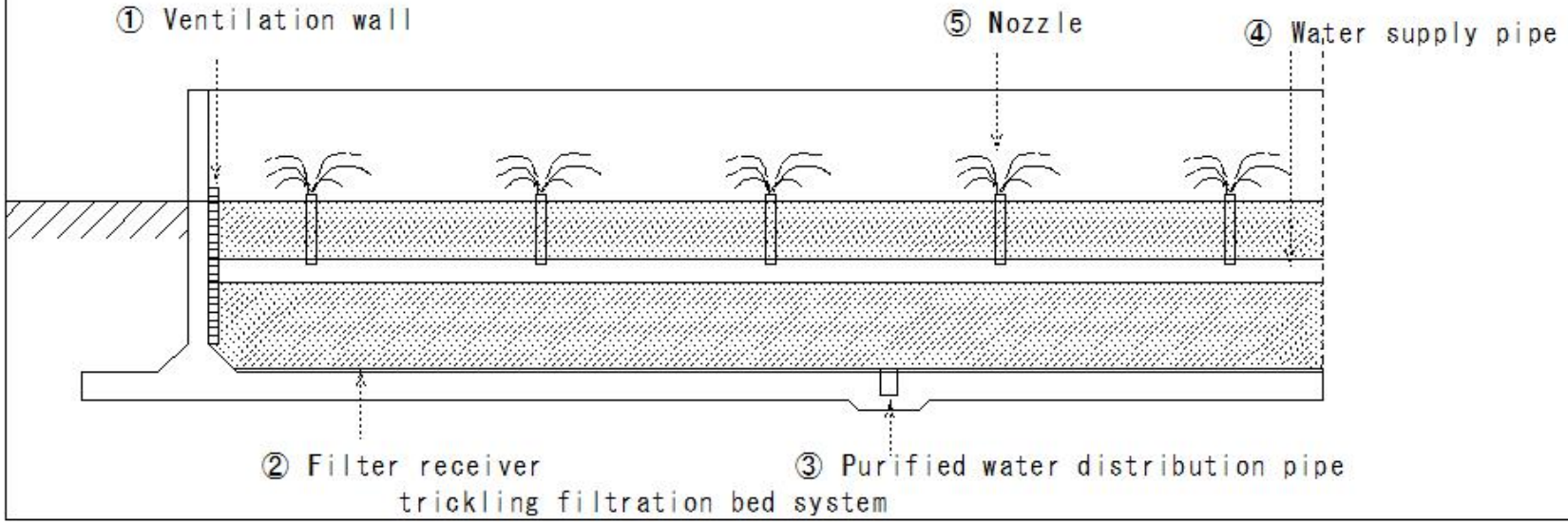
Sewage treatment method

Filter: diameter 2-10cm, crushed stone, coke: 1.5-2.5m

Filter

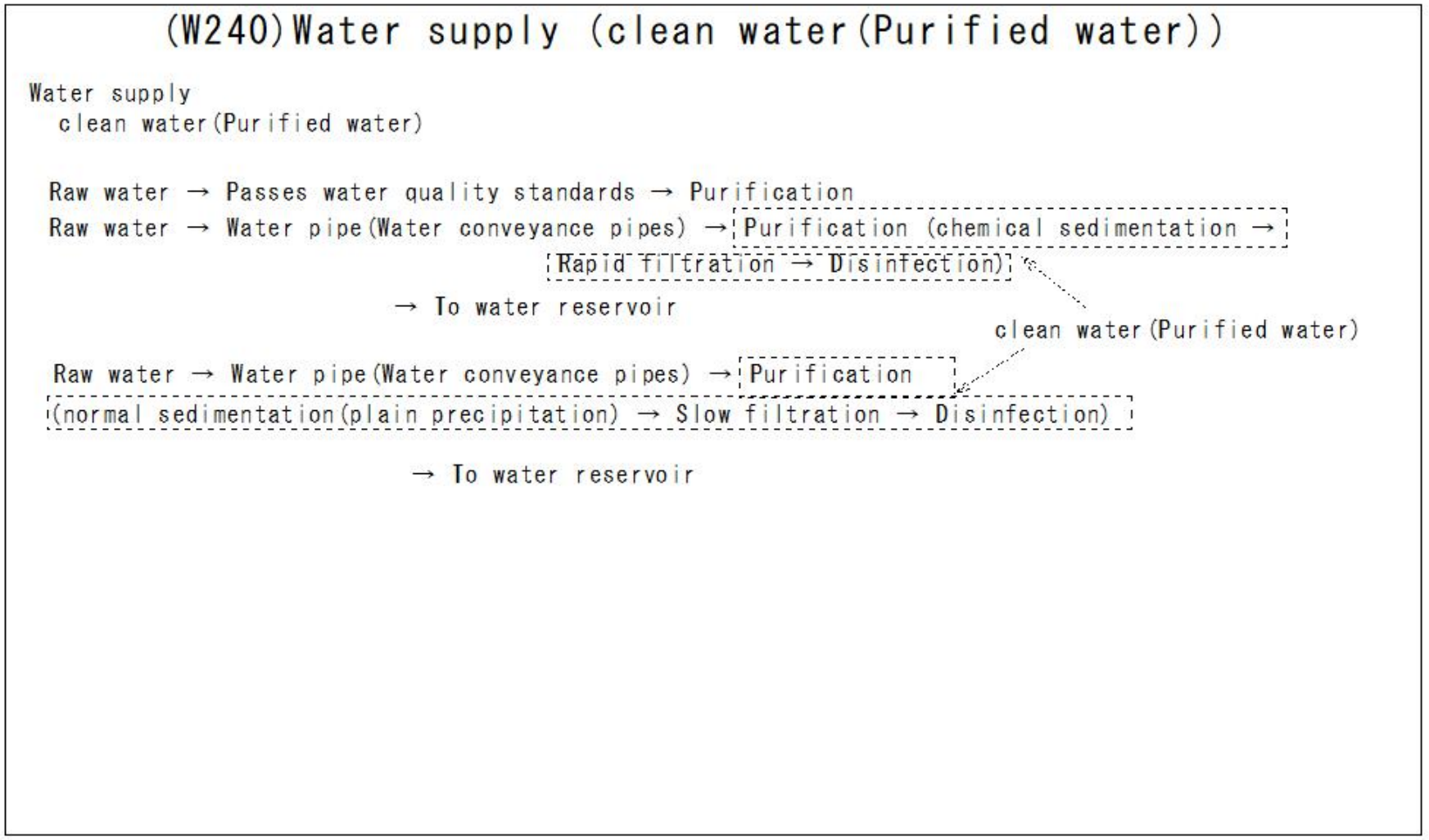
Sewage is sprinkled from above

Sewage is treated by breeding organisms that decompose organic matter in sewage on the surface of crushed stone, etc.

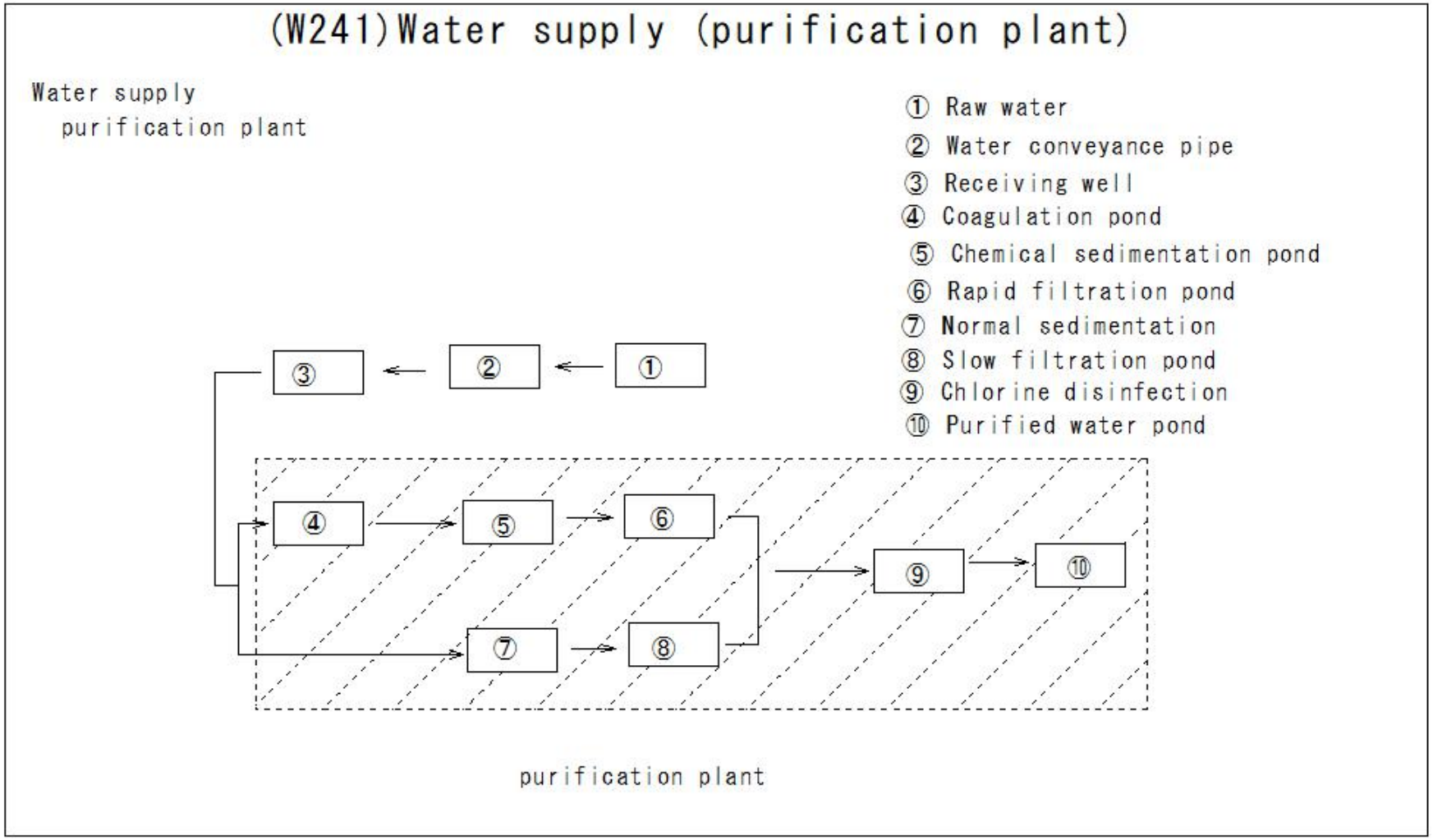


trickling filtration bed system

(W240)Water supply (clean water(Purified water))



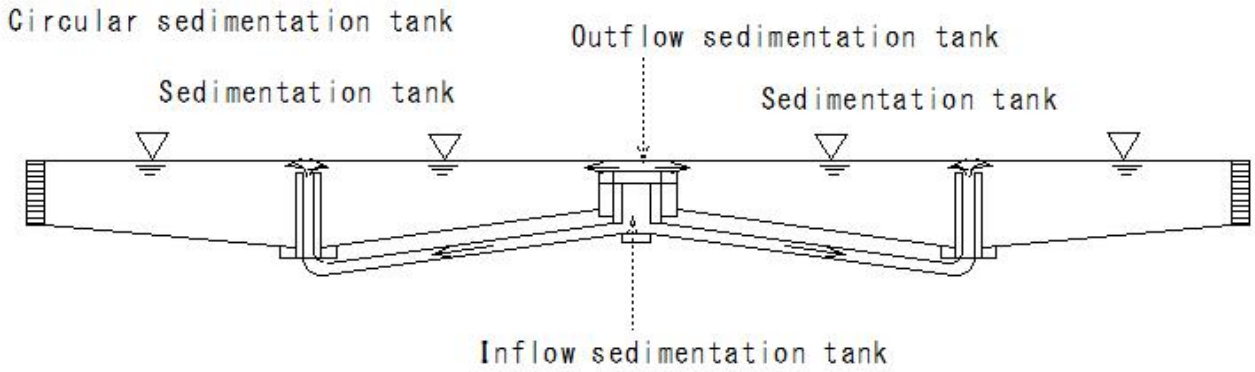
(W241)Water supply (purification plant)



(W242)Water supply (continuous flow setting basin)

(W242)Water supply (continuous flow setting basin)

Water supply
continuous flow setting basin
A type of sedimentation tank for water purification



A type of sedimentation tank for water purification

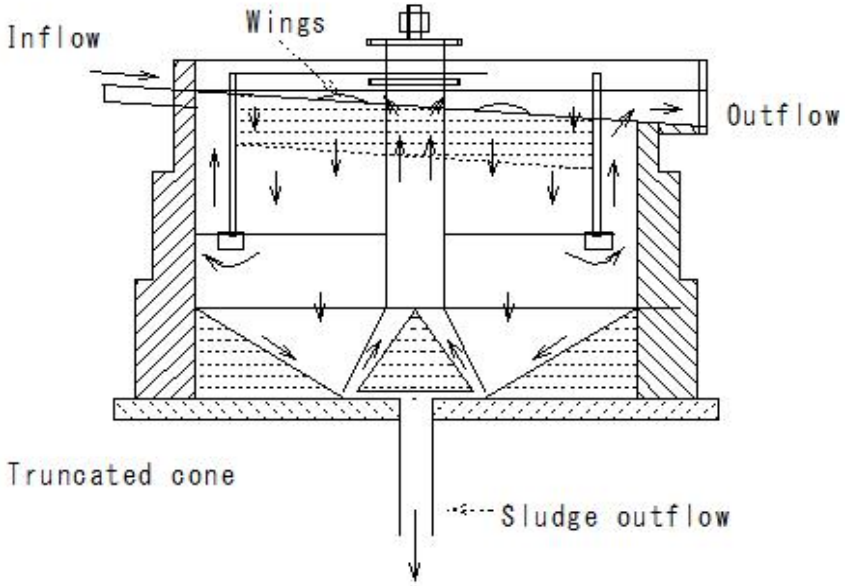
(W243)Sewerage(simplex system)

(W243)Sewerage(simplex system)

Sewerage

Simplex system

Aeration method for activated sludge treatment of sewage



(W244)Sewerage(thickner（Sludge scraper）)

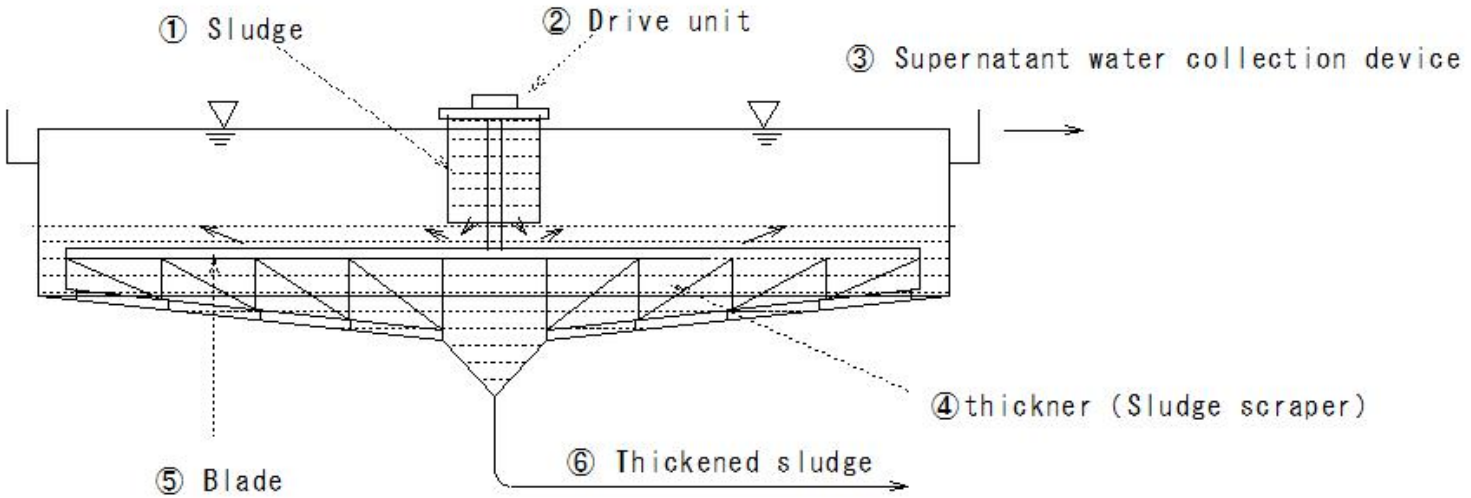
(W244)Sewerage(thickner (Sludge scraper))

Sewerage

thickner (Sludge scraper)

Sewage treatment plant

Machine scrapes and collects settled sludge



thickner (Sludge scraper)

(W245)Sewerage(sludge treatment)

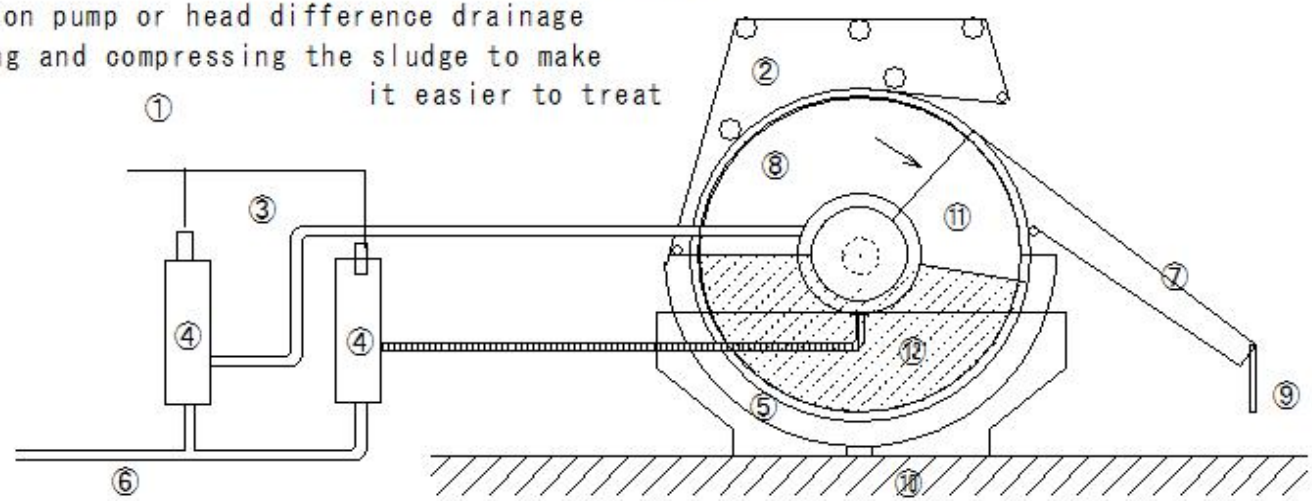
(W245)Sewerage(sludge treatment)

Sewerage

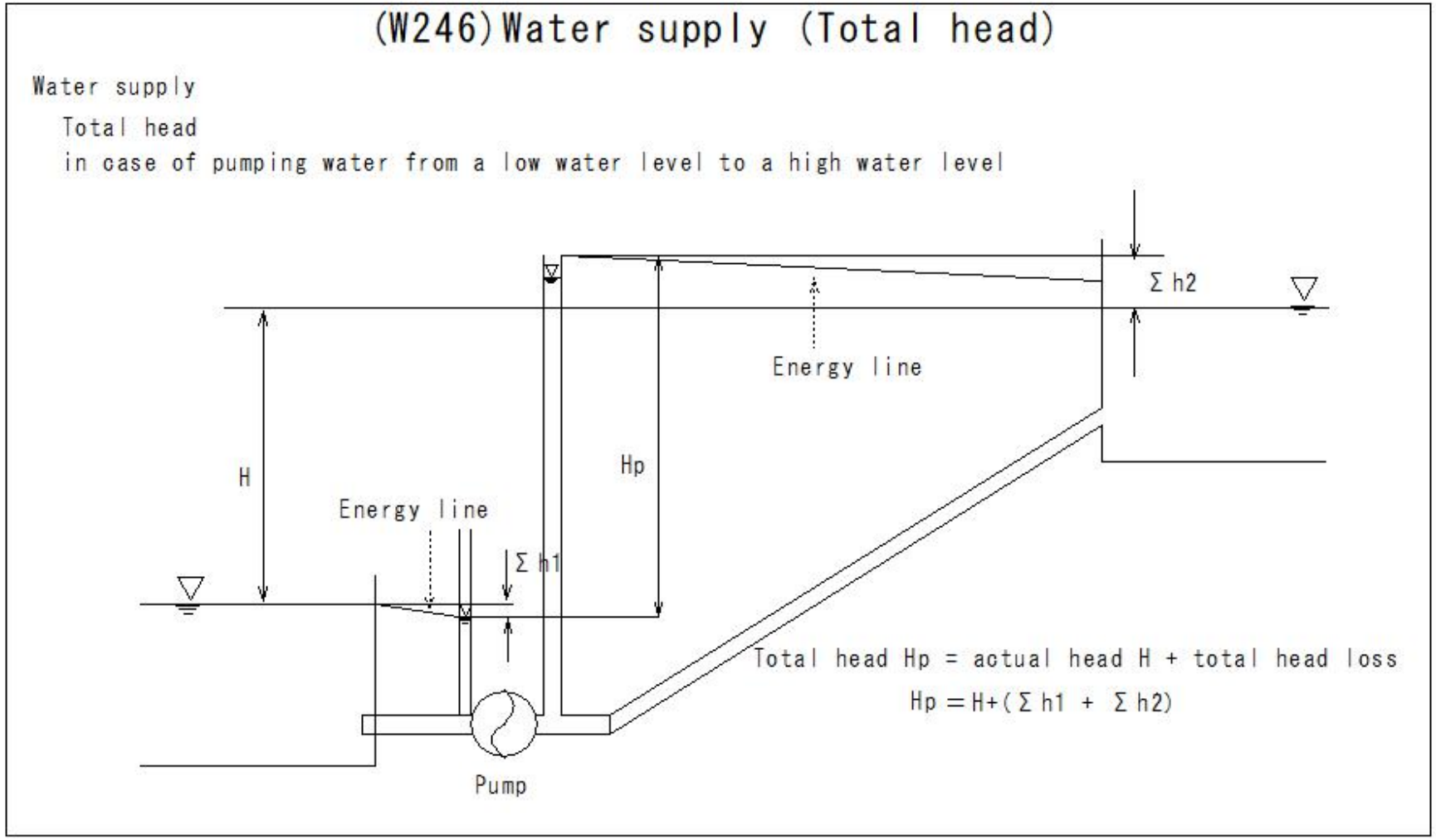
Sludge treatment

The sludge (mud) generated during the sewage treatment process is treated by dehydrating, drying, incinerating, etc.

① Vacuum filter
② Compression roller
③ Vacuum pump
④ Vacuum tank
⑤ Sludge
⑥ Distribution pump or head difference drainage
⑦ Dehydrating and compressing the sludge to make it easier to treat
⑧ High vacuum
⑨ Cake (dehydrated sludge)
⑩ Vacuum filter
⑪ Stripping normal pressure
⑫ Low vacuum



(W246)Water supply (Total head)



(W247)Water supply (water-conveyance equipment(Water supply facility))

(W247)Water supply (water-conveyance equipment(Water supply facility))

Water supply

water-conveyance equipment(Water supply facility)

Water supply pipe from water purification area

Pumping to water supply reservoir

①Filtration pond

②Water supply pump

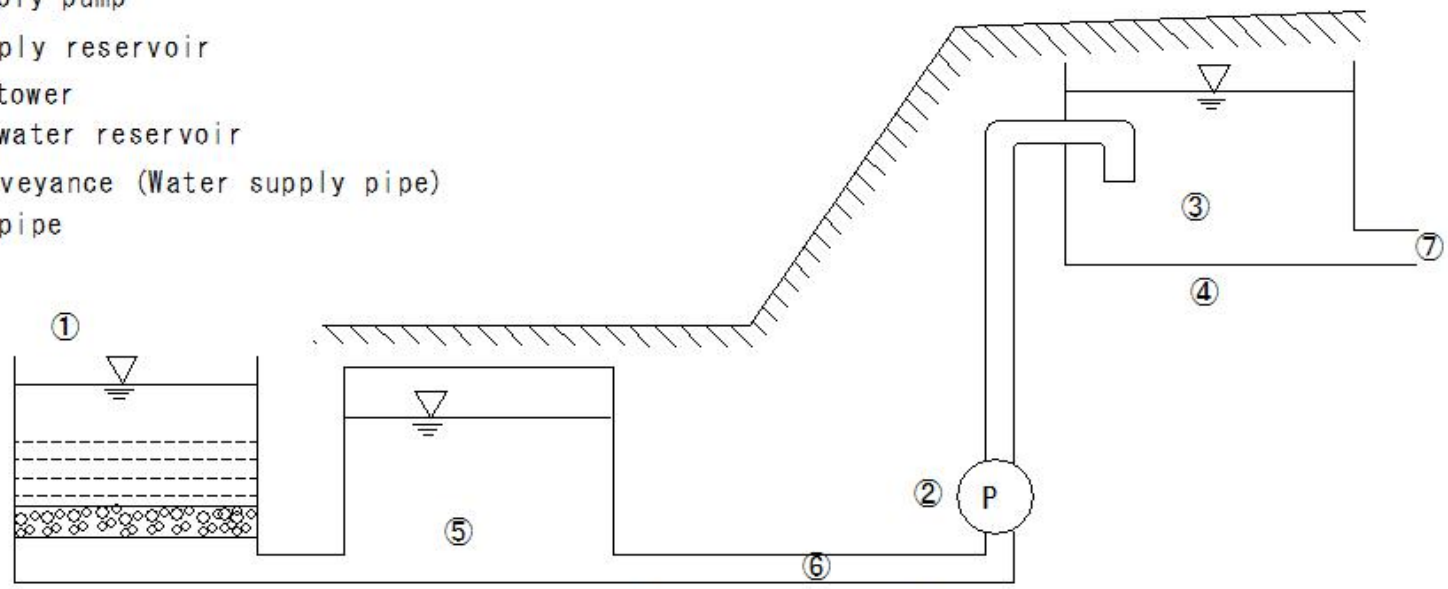
③Water supply reservoir

④Drainage tower

⑤Purified water reservoir

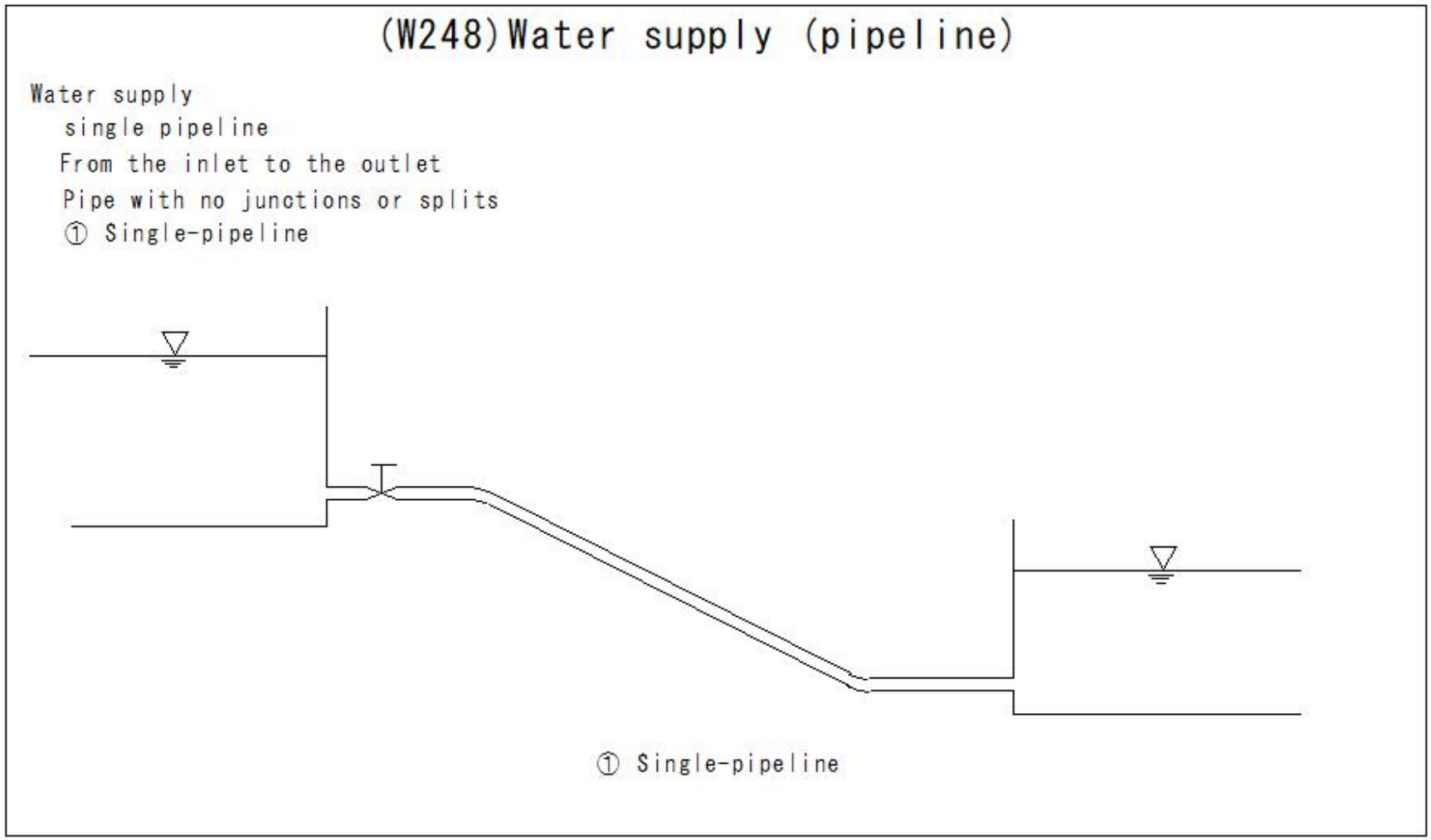
⑥water-conveyance (Water supply pipe)

⑦Drainage pipe



water-conveyance equipment(Water supply facility)

(W248)Water supply (pipeline)



(W249)Water supply (pipeline)

(W249)Water supply (pipeline)

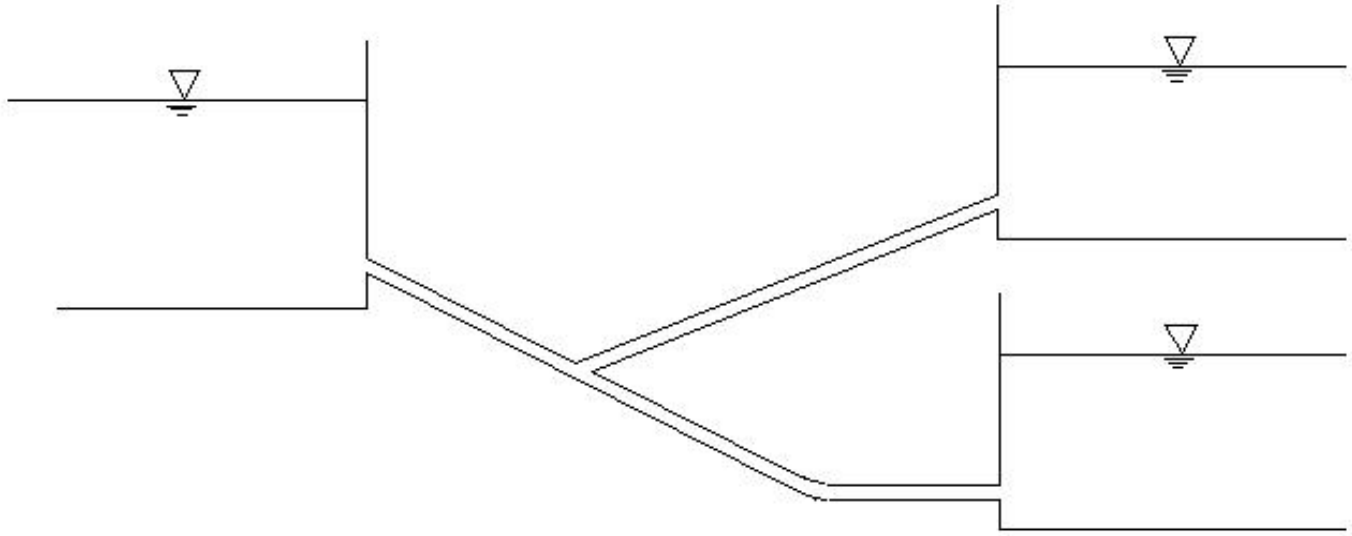
Water supply

single pipeline

From the inlet to the outlet

Pipe with no junctions or splits

② Branched pipeline



② Branched pipeline

(W250)Water supply (pipeline)

(W250)Water supply (pipeline)

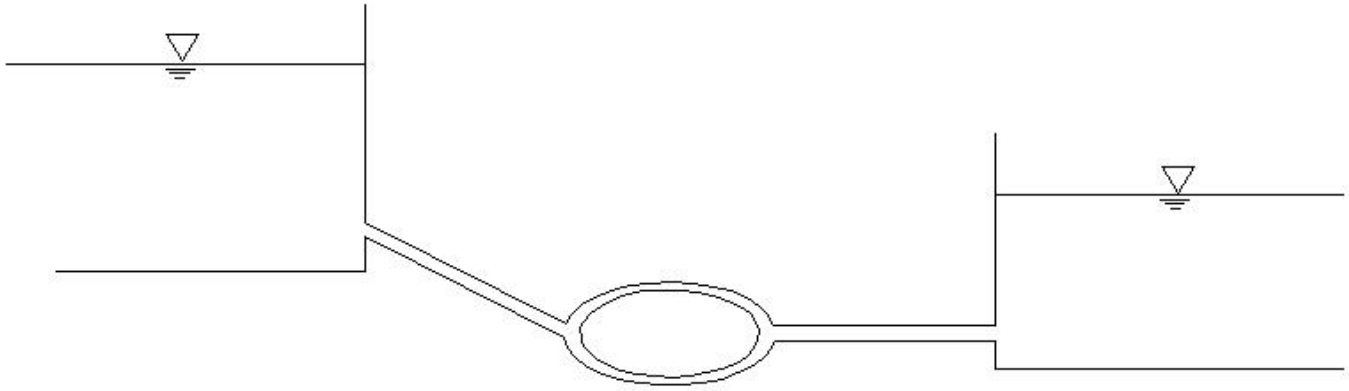
Water supply

single pipeline

From the inlet to the outlet

Pipe with no junctions or splits

③ Pipe with some double pipelines



③ Pipe with some double pipelines

in case of pipes intersect, the sum of the inflows is equal to the sum of the outflows

(W251)Water supply (pipeline)