City of Oakland

COMMUNITY & ECONOMIC DEVELOPMENT AGENCY
250 FRANK H. OGAWA PLAZA
4TH FLOOR • OAKLAND • CALIFORNIA • 94612
(510) 238-3437 FAX (510) 238-7227 TTD (510) 238-3254

Department of Engineering and Construction

Sanitary Sewer Design Standards

Effective Date: August 2008

APPROVED:

Michael, J. Neary, P.E.
Deputy Director

Aug. 14, 2008
Date

Sanitary Sewer Design Standards

Engineering Design & ROW Management Division
Department of Engineering and Construction
Community & Economic Development Agency

City of Oakland

Michael Neary, P.E.
Deputy Director

Gus Amirzehni, P.E.
Principal Civil Engineer

Prepared by:
Ferdinand Ciceron, P.E.

Contributors/Advisors:
Kevin Kashi, P.E.
Allen Law, P.E.
Gunawan Santoso, P.E.
Alfredo Valdivia, P.E.
Patrick Phelan

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1. Introduction

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All sanitary sewers shall be designed in accordance with these Design Standards and to accepted engineering principles. In all newly developed areas and/or in all existing areas where new sanitary sewers are required, the design shall include the provisions that the sewer system size and capacity can adequately accommodate the ultimate anticipated conditions. **Under no circumstances shall any type or form of storm drain system be connected to any sanitary sewer system. (Oakland Municipal Code 13.08.140)**

2. Design Criteria

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These criteria have been collected from various resources and they are meeting accepted standards for sanitary sewer design in the City of Oakland. The Design Engineer shall use these criteria to estimate design flows as accurately as possible. Calculations shall be submitted to the City of Oakland for approval.

These criteria shall be considered to determine the projected flow:

- Tributary areas
- Estimate of population
- Land use
- Use-specific flow rates for
    - Residential
    - Commercial
    - Industrial
- Major point source discharge
- Ground water
- Infiltration and Inflow

Tributary area of a sewer shall include all areas that will contribute flow to the sewer system. It shall include flows from the developed area to the point of connection to main line.

Estimate of population shall be for the proposed development and shall be as accurate as possible.

Land use contributes and defines the densities of population and the type of users contributing to the flow within the tributary areas. To verify that the projection is reasonable, zoning maps and field review may be used.

Where uses are planned for an area, the average flow rates shown in Table 1 shall be used to estimate flows.

Industrial flow may vary significantly per industry type, size and the way wastewater is being discharged. The Design Engineer shall determine the magnitude of the industries' wastewater contribution in the area.

Major discharges from future point sources shall be incorporated in the design flow. Future development of major establishments should be ascertained from the available information, including the City's General Plan, Zoning and Land Use maps.

Infiltration/Inflow shall be added to the design total flow.

3. Design Flow Calculation

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The design sewage flow rate (Q) is computed by the following:

$$Q = [gADM]_{peak} + [IA]_{infiltration}$$

Where: Q = total flow
A = tributary area, in acres*****
D = future population density, persons per acre*****
g = average flow rate*****
M = coefficient for Peak Flow

$$= 1 + \frac{14}{4 + (\text{population in } 1000\text{s})^{1/2}} \text{ , where } 3.75 \geq M \geq 2.00$$

I = infiltration rate = 1000 gallons / day / acre

***** For specific occupancy development, use Table 1 and apply the appropriate average daily flows.

4. Pipe Flow

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- Pipes shall be of sufficient size to handle the total design flow, Q.
- Main sewers and local collectors shall be designed with sewers flowing 2/3 full, $d/D \leq 2/3$.
- Trunk sewers shall be designed with sewers flowing full without surcharge, $d/D \leq 1.0$
- For locations of Sewer Trunk Lines, refer to List of Figures taken from Sewer System Evaluation Survey (SSES) for North Oakland and South Oakland.

5. Pipe Design

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- Sewer pipes shall be designed for minimum velocity of 2 feet per second.
- The minimum pipe size for sanitary sewer is 8" inside diameter.
- If a flatter slope is proposed, the pipe shall be designed to prevent settlement of solids in the pipe.
- The design flow velocity shall not exceed 10 feet per second unless warranted by special conditions.
- A minimum of 10 feet wide easement shall be required for sewer within private properties.

6. Pipe Materials (minimum standard)

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All pipes shall be designed to withstand an H-20 highway loading and existing sub-surface conditions. The following pipe materials are permitted for sanitary sewers. Roughness coefficient shall be the greater of 0.013 or the pipe manufacturer's design recommendation.

- Vitrified Clay Pipe (VCP) – extra strength or high strength per ASTM C700
- Ductile Iron Pipe (DIP), Class 52 with approved lining/coating
- Solid Wall High Density Polyethylene (HDPE) Pipe SDR 11 with smooth interior (engineering pipe design calculations shall be required)
- Reinforced Concrete Pipe (RCP) with an approved type, D-load, and lining/coating
- Cast Iron Pipe (CIP) with an approved lining/coating

The following pipe materials shall not be used for sanitary sewer construction.

- ABS (Acrylonitrile Butadiene Styrene) Pipes
- PVC (Poly Vinyl Chloride) Pipes
- CMP (Corrugated Metal Pipe) Pipes

7. Connections

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Sanitary sewer mains shall be located in the street along the centerline whenever possible and shall not be located underneath the sidewalk or along the curb and gutter.

Sanitary sewer pipes shall run in a straight alignment and no curved or deflected pipes shall be permitted.

The main sewer lines may be connected into a manhole at a maximum distance of 18" above the flow line of the manhole without a drop connection. Connections made over 18" will be required to have a drop connection. Refer to Standard Detail D-2.

A manhole is required when an 8" and larger sewer lateral is connected into a sewer main.

Laterals shall be connected at 90-degree angle to the main sewer. The last two laterals shall be connected to the main with the use of a wye-connection. All other laterals may be connected with the use of a T-connector or wye-connection. The wye shall be located in the direction of flow. The minimum distance to the first lateral from a sewer structure shall be 3 feet, and from the last lateral to a cleanout shall be 5 feet.

For pipe crossing and clearance requirements, see Standard Detail D-23 and the appropriate health and safety guidelines. Load calculation shall be submitted for approval.

8. Sewer Structures (manholes & cleanouts)

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- Manholes shall not be placed more than 300 feet apart.
- Manholes shall be placed at junctions of lines and shall be used at changes in vertical and horizontal alignments.
- A cleanout shall be installed at the end of all sewer lines.

9. Pipe Cover

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All pipes shall be designed to withstand an H-20 highway loading and existing sub-surface conditions.

For rigid pipes, desired minimum cover to sub-grade in locations where the pipe is subject to vehicular loads is three (3') feet. Where the depth of the public sewer main is such that the three (3') feet minimum depth below the top of grade elevation cannot be attained, refer to Standard Detail D-1, the sewer shall be covered with at least four (4") inches of concrete or shall be Ductile Iron Pipe Class 52 or Reinforced Concrete Pipe, Class V with an approved lining/coating.

For rigid pipes, the maximum depth of cover shall be not more than 13.5 feet. For depth of cover more than 13.5 feet refer to Standard Detail D-1. Class IV reinforced concrete pipe with approved lining/coating or ductile iron pipe Class 52 may be acceptable with design calculation.

Shoring is required for all trenches over five (5') feet deep. This is required for work on private property as well as street work (refer to Cal/OSHA regulations).

For sewer construction trench detail, back-fill material and compaction requirements, refer to Standard Detail D-22.

If flexible pipes are proposed, the design engineer shall submit detailed load calculations for pipe design for the approval of the City.

Prior to acceptance, all new or completely replaced sewers and sewer structures shall be water and/or air tested, and closed circuit televised in accordance with the current City of Oakland Standard Specifications.

10. Sewer Laterals

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- Laterals shall have a minimum of 2% slope
- The minimum size of the 2-way cleanout shall be 4 inches and shall be placed behind curb as to be accessible at all times

11. Permitting

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Permits are required for all sewer work, including but not limited to the following:

- Private construction of public infrastructure (P-Job)
- Excavation
- Street Obstruction
- Traffic control
- Other as necessary

12. Sewer Lines in Unusual Conditions

TOC

Where sewer pipe is exposed, a properly supported casing and carrier pipe system may be used with proper erosion control measures. For slopes exceeding 20 degrees or where pipe is to be installed in an unstable ground or soil conditions, the City requires stabilization of the area in accordance with geotechnical reports with specific design recommendations to support the proposal and all maintenance activities by the City. Geotechnical reports and design recommendations are subject to peer review.

For creek side properties or any area that may be categorized as such, the entire development and the proposed facility shall be subject to the requirements stated in the City's Creek Ordinance. For information, refer to: to http://www.oaklandpw.com/creeks/guide.htm. For information regarding drainage issues, refer to the City's Storm Drainage Design Standards: http://www.oaklandnet.com/cedahome_com/SiteData/cedahome/InetPub/wwwroot/main/dcsd_technicallibrary.asp

13. Submittals and Drawing Standards

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Sewer drawing submittals shall include engineering plan/profile, lots to be serviced, laterals, property lines, and existing or proposed lines that may be close to or crossing the proposed sewer main. Sewer lines in paths, reserves or easements must indicate all existing improvements such as buildings, fences, trees, etc., including any watercourse. Sewer lines crossing watercourses will be required to have erosion control measures constructed along the watercourse and over the proposed sewer lines. Plans shall show the width of the easement and relative location of sewer line within the easement. Minimum easement width shall be 10 feet unobstructed, without encroachment of any improvement. Sewers shall be located along the centerline of the easement.

Distances between structures are to be shown as ± to the nearest foot (even if field measured). Tie structures and lines to monument lines, if available. Otherwise, tie to street lines, curb, points or easement lines with exact distances.

Construction drawing shall conform to the City's Drafting Standards. Drawing scales shall be 1:40 horizontally and 1:4 vertically, or 1:20 and 1:5, 1:50 and 1:5. The scales used shall be so indicated on the plan sheets.

All elevations shall be based upon the City of Oakland datum and shall be shown on the plans at all points having a change of grade. Cuts to the nearest one-half foot shall be shown on the plans at all structures and at other significant points.

Sanitary Sewer Plan Review Checklist is attached as Appendix E.

14. Pump Systems

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Special design of sewer force mains or other unusual features or structures require individual study and approval by the Engineer.

All proposed sanitary sewer pump systems shall be submitted to the Engineer for determination of any circumstances to necessitate the pump design and its usage.

Submersible pump system proposed for residential use may be considered if the installation as a whole will be in conformance with the California Electrical Code and the California Division of Industrial Safety or any codes that may be applicable. In general, a raw sewage sump is classified as a hazardous location, which requires explosion proof equipment with UL label or equivalent construction. Float control equipment must have positive level control to preclude exposing the motor if the motor is not explosion proof. Where electrical devices are immersed in the sewage, controls must be safe with redundant controls and positive cutoff to avoid automatic total pump down that would expose motor where motor is not explosion proof.

15. Source Control

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Use of sanitary sewer system is regulated by Oakland Municipal Code 13.08.130 to 13.08.200. Wasterwater discharge is monitored by EBMUD.

16. Submittals and Final As-Built Prior to Acceptance

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For any new development, engineering calculations used for the design of all proposed sanitary sewer systems shall be submitted to the Engineer for review. The calculations shall include the following items:

- A plan showing proposed street system, existing and future tributary areas, current zoning, projected land use and any feature affecting the system design.
- Design flows including flows coming from outside the project limits.
- Pipe capacities, design flow and the percent of full pipe capacity used for each sanitary sewer reach, hydraulic profile for each pipe.
- Pipe size, length, slope, Manning's roughness coefficient (n), rim and invert elevations, based on the City of Oakland datum, of all proposed lines and locations of manholes and cleanouts.
- Analysis of the impact of the proposed development on the existing sanitary sewer system capacity. If the existing sewer system is under capacity, the developer is responsible for repairing or replacing the sanitary sewer pipes as a part of the conditions of approval on the building permit.
- Prior to acceptance, the final as-built sanitary sewer improvement plans shall be submitted to the City of Oakland's Public Works Agency Engineering Design and Right-of-Way Management Division in AutoCad™ files (unprotected, not read only, or password protected).

17. Impact Analysis and Mitigation Fee

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The City of Oakland's infiltration/inflow correction program consists of a 25-year capital improvement program that calls for the rehabilitation of the existing system in cost-effective areas and adding additional pipe capacity where needed. This program anticipated a 20% additional development (20% growth rate) for most parts of Oakland. Some financial and business districts were assigned a higher rate than 20%.

With the completion of this 25-year program (rehabilitation of cost-effective sub-basins and construction of additional relief sewers) the City's wastewater collection system will have the sufficient capacity to accommodate the growth anticipated at the time of the initial program study and the resulting increase in wastewater flows.

If development and growth rate were to exceed the program projections, then the capacity of the system must be increased along with the capacity of other transport and treatment facilities.

A. Impact Analysis for New Development

All new development or redevelopment projects will require an impact analysis to ensure that the existing system has enough hydraulic capacity to accommodate the proposed development.

The City's collection system is comprised of local collection mains and a network of trunk pipe system. The entire system is divided into drainage basins and sub-basins. See List of Figures. The City's capacity improvement program has focused only on the trunk system assuming that the remainder of the system--local mains--have sufficient capacity.

The City's impact analysis ensures that the overall development is within the projected growth. If the net increase in wastewater flow exceeds projections, the impact analysis must include both local and trunk systems. Further, the impact analysis must be expanded to include impact on other regional facilities. If the net increase in wastewater flow is within the projections, then this impact analysis may be limited to the study of local mains serving the development.

B. Mitigation Fee for Certain Development

Mitigation fee is assessed to all new development or redevelopment in sub-basins that have a growth rate greater than 20%. The fee represents the development's buy-in for the cost of the City's improvements identified by the 25-year plan in anticipation of the development.

The City of Oakland Master Fee Schedule authorizes the assessment of the Sewer Mitigation Fee. This fee is site-specific to each development and is based on an engineering analysis. In general, it represents the development's proportional share of the growth-induced improvement costs commensurate with its net contribution of additional wastewater into the City's system. For calculating this fee, the following flow rate information must be submitted to the City:

1. Existing average daily wastewater flow with engineering calculations
2. Proposed average daily wastewater flow with engineering calculations
3. Proposed peak daily wet-weather wastewater flow with engineering calculations

18. Tables

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Table 1 – Average Flow Rate on Specific Developments

Development	Ave Daily Flow, gpd/unit	Unit
Auditorium	5	Seat
Automobile parking	25	1000 Gross square feet
Automobile repair garage	100	1000 Gross square feet
Bakery	300	1000 Gross square feet
Bar	20	Seat
Cafeteria	50	Seat
Carwash – coin operated	206	Stall
Carwash – in bay	412	5 gallons per minute (peak)
Church – fixed seat	5	Seat
Commercial	100	1000 Gross square feet
Community center	5	Occupant
Gymnasium	300	1000 Gross square feet
Hospital - Convalescent	85	Bed
Hospital – dog and cat	300	1000 Gross square feet
Hospital – non-profit	85	Bed
Hospital - surgical	500	Bed
Industrial	412	Gallons per minute (peak)
Jail	85	Inmate
Dog kennel / open	100	1000 Gross square feet
Laboratory - commercial	300	1000 Gross square feet
Laundromat - industrial	412	Gallons per minute (peak)
Laundromat	220	Washer
Manufacturing - industry	100	1000 Gross square feet
Medical building	300	1000 Gross square feet
Motel	150	Room
Office building	200	1000 Gross square feet
Dormitory – college or residential	85	Student
Residential – townhouses, set grade	330	Dwelling unit
Residential – bachelor/single	100	Dwelling unit
Residential – 1 bedroom apartment or condominium	150	Dwelling unit
Residential – 2 bedrooms apartment or condominium	200	Dwelling unit
Residential – 3 bedrooms apartment of condominium	250	Dwelling unit
Residential – boarding house	85	Bed
Residential - duplex	300	Dwelling unit
Residential – mobile home	200	Home space
Residential – single family dwelling	330	Dwelling unit
Residential – artist dwelling (2/3 area)	300	1000 Gross square feet
Residential – artist dwelling	100	Dwelling unit

Table 1 – Average Flow Rate on Specific Developments (cont'd)

Development	Ave Daily Flow, gpd/unit	Unit
Residential – guest house with kitchen	330	Dwelling unit
Rest home	85	Bed
Restaurant – fixed seat	50	Seat
Restaurant – take out	300	1000 Gross square feet
Retail area	100	1000 Gross square feet
School – day care center	10	Child
School – elementary / junior high	10	Student
School – high school	15	Student
School - kindergarten	10	35 Gross square feet
Theater – fixed seat	5	Seat

Conversion Factors:

cfs = 449 gpm

MGD = 1.55 cfs = 695 gpm

cu ft = 7.48 gal

19. List of Figures

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For North Oakland:

North Oakland Collection System

For South Oakland:

South Oakland Collection System

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APPENDICES

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B. Standard Detail Drawing D-2
C. Standard Detail Drawing D-22
D. Standard Detail Drawing D-23
E. Sanitary Sewer Plan Review Checklist