UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 9
75 Hawthorne Street
San Francisco, CA 94105

In Re:

GOLETA SANITARY DISTRICT'S APPLICATION FOR A MODIFIED NPDES PERMIT UNDER SECTION 301(h) OF THE CLEAN WATER ACT	TENTATIVE DECISION OF THE REGIONAL ADMINISTRATOR PURSUANT TO 40 CFR PART 125, SUBPART G

I have reviewed the attached evaluation analyzing the merits of the application of the Goleta Sanitary District requesting a variance from secondary treatment requirements of the Clean Water Act (the Act), pursuant to section 301(h). It is my tentative decision that Goleta Sanitary District be granted a variance in accordance with the terms, conditions, and limitations of the attached evaluation, based on section 301(h) of the Act.

My decision is based on available evidence specific to this particular discharge. It is not intended to assess the need for secondary treatment in general, nor does it reflect on the necessity for secondary treatment by other publicly owned treatment works discharging to the marine environment. This decision and the National Pollutant Discharge Elimination System (NPDES) permit implementing this decision are subject to revision on the basis of subsequently acquired information relating to the impacts of the less-than-secondary discharge on the marine environment.

Under the procedures of the Permit Regulations, 40 CFR Part 124, public notice and comment regarding this decision and accompanying draft NPDES permit will be made available to interested persons. Following the public comment period on this tentative decision and draft permit, a final decision and permit will be issued under the procedures in 40 CFR Part 124.

Dated: January 19, 2010

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Jared Blumenfeld
Regional Administrator

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INTRODUCTION

The Goleta Sanitary District (the applicant or Goleta) is requesting renewal of its variance (sometimes informally called a "waiver" or "modification") under section 301(h) of the Clean Water Act (the Act or CWA), 33 U.S.C. section 1311(h), from the secondary treatment requirements contained in section 301(b)(1)(B) of the Act, 33 U.S.C. section 1311(b)(1)(B), for the Goleta Wastewater Treatment Plant (the plant), a publicly owned treatment works (POTW). The 301(h) variance would allow the discharge of wastewater receiving less-than-secondary treatment to the Pacific Ocean.

The U.S. Environmental Protection Agency, Pacific Southwest Region (the EPA Region IX or EPA) and the California Regional Water Quality Control Board, Central Coast (the Regional Board) issued a 301(h) modified NPDES permit to the applicant in 1985 (Permit No. CA0048160). EPA and the Regional Board renewed the modified permit on July 26, 1996, and again on November 19, 2004 after Goleta signed a Settlement Agreement with the Regional Board on November 10, 2004, committing the Plant to convert to full secondary treatment by 2014. The 2004 modified permit expired on November 19, 2009, but is administratively extended pending EPA's decision on Goleta's application for renewal of a 301(h) variance and modified permit, submitted to EPA on May 29, 2009.

This document presents findings, conclusions, and recommendations of EPA Region IX regarding the compliance of the applicant's proposed discharge with the criteria set forth in section 301(h) of the Act, as implemented by regulations contained in 40 CFR Part 125, Subpart G.

Secondary treatment is defined in the regulations (40 CFR Part 133) in terms of effluent quality for total suspended solids (TSS), biochemical oxygen demand (BOD) and pH. The secondary treatment requirements for TSS, BOD and pH are listed below:

TSS: (1) The 30-day average shall not exceed 30 mg/l.
(2) The 7-day average shall not exceed 45 mg/l.
(3) The 30-day average percent removal shall not be less than 85%;

BOD: (1) The 30-day average shall not exceed 30 mg/l.
(2) The 7-day average shall not exceed 45 mg/l.
(3) The 30-day average percent removal shall not be less than 85%;

pH: At all times, shall be maintained within the limits of 6.0 to 9.0 units.

The applicant is requesting a modification to the TSS and BOD requirements. A modification for pH is not requested. The applicant's proposed alternative effluent limits for TSS and BOD have not changed from the existing modified permit and are as follows:

TSS: (1) The 30-day average shall not exceed 63 mg/l.
(2) The maximum at any time shall not exceed 100 mg/l.
(3) The 30-day average percent removal shall not be less than 75%.

BOD: (1) The 30-day average shall not exceed 98 mg/l.
(2) The maximum at any time shall not exceed 150 mg/l.

The plant provides full primary and partial secondary wastewater treatment for a service population of about 82,000. The application is based on the plant's existing modified permit, an average dry-weather flow limited to 7.64 million gallons per day (MGD). Based on the definition in 40 CFR 125.58(c), the applicant is a large discharger.

DECISION CRITERIA

Under section 301(b)(1)(B) of the Act, 33 U.S.C. section 1311(b)(1)(B), publicly owned treatment works (POTWs) in existence on July 1, 1977, were required to meet effluent limits based upon secondary treatment as defined by the Administrator of EPA. The Administrator defined secondary treatment in terms of three parameters: TSS, BOD, and pH. Uniform national effluent limits for these pollutants were promulgated and included in National Pollutant Discharge Elimination System (NPDES) permits for POTWs issued under section 402 of the Act. POTWs were required to comply with these limits by July 1, 1977.

Congress subsequently amended the Act, adding section 301(h) which authorizes the Administrator, with State concurrence, to issue NPDES permits which modify the secondary treatment requirements of the Act with respect to certain discharges. P.L. 95-217, 91 Stat. 1566, as amended by P.L. 97-117, 95 Stat. 1623; and section 303 of the Water Quality Act of 1987. Section 301(h) provides:

> The Administrator, with the concurrence of the State, may issue a permit under section 402 [of the Act], which modifies the requirements of subsection (b)(1)(B) of this section [the secondary treatment requirements] with respect to the discharge of any pollutant from a publicly owned treatment works into marine waters, if the applicant demonstrates to the satisfaction of the Administrator that:
>
> (1) there is an applicable water quality standard specific to the pollutant for which the modification is requested, which has been identified under section 304(a)(6) of this Act;
>
> (2) the discharge of pollutants in accordance with such modified requirements will not interfere, alone or in combination with pollutants from other sources, with the attainment or maintenance of that water quality which assures protection of public water supplies and the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife, and allows recreational activities, in and on the water;
>
> (3) the applicant has established a system for monitoring the impact of such discharge on a representative sample of aquatic biota, to the extent practicable, and the scope of such monitoring is limited to include only those scientific investigations which are necessary to study the effects of the proposed discharge;
>
> (4) such modified requirements will not result in any additional requirements on any other point or non-point source;
>
> (5) all applicable pretreatment requirements for sources introducing waste into such treatment works will be enforced;
>
> (6) in the case of any treatment works serving a population of 50,000 or more, with respect to any toxic pollutant introduced into such works by an industrial

discharger for which pollutant there is no applicable pretreatment requirement in effect, sources introducing waste into such works are in compliance with all applicable pretreatment requirements, the applicant will enforce such requirements, and the applicant has in effect a pretreatment program, which, in combination with the treatment of discharges from such works, removes the same amount of such pollutant as would be removed if such works were to apply secondary treatment to discharges and if such works had no pretreatment program with respect to such pollutant;

(7) to the extent practicable, the applicant has established a schedule of activities designed to eliminate the entrance of toxic pollutants from nonindustrial sources into such treatment works;

(8) there will be no new or substantially increased discharges from the point source of the pollutant to which the modification applies above that volume of discharge specified in the permit;

(9) the applicant at the time such modification becomes effective will be discharging effluent that has received at least primary or equivalent treatment and which meets the criteria established under section 304(a)(1) of the Act after initial mixing in the waters surrounding or adjacent to the point at which such effluent is discharged.

For the purposes of this subsection the phrase "the discharge of any pollutant into marine waters" refers to a discharge into deep waters of the territorial sea or the waters of the contiguous zone, or into saline estuarine waters where there is strong tidal movement or other hydrological and geological characteristics which the Administrator determines necessary to allow compliance with paragraph (2) of this subsection, and section 101(a)(2) of this Act. For the purposes of paragraph (9), "primary or equivalent treatment" means treatment by screening, sedimentation, and skimming adequate to remove at least 30 percent of the biological oxygen demanding material and of the suspended solids in the treatment works influent, and disinfection, where appropriate. A municipality which applies secondary treatment shall be eligible to receive a permit pursuant to this subsection which modifies the requirements of subsection (b)(1)(B) of this section with respect to the discharge of any pollutant from any treatment works owned by such municipality into marine waters. No permit issued under this subsection shall authorize the discharge of sewage sludge into marine waters. In order for a permit to be issued under this subsection for the discharge of a pollutant into marine waters, such marine waters must exhibit characteristics assuring that water providing dilution does not contain significant amounts of previously discharged effluent from such treatment works. No permit issued under this subsection shall authorize the discharge of any pollutant into saline estuarine waters which at the time of application do not support a balanced, indigenous population of shellfish, fish, and wildlife, or allow recreation in and on the waters or which exhibit ambient water quality below applicable water quality standards adopted for the protection of public water supplies, shellfish, fish, and wildlife or recreational activities or such other standards necessary to assure support and protection of such uses. The prohibition contained in the preceding

sentence shall apply without regard to the presence or absence of a causal relationship between such characteristics and the applicant's current or proposed discharge. Notwithstanding any other provisions of this subsection, no permit may be issued under this subsection for discharge of a pollutant into the New York Bight Apex consisting of the ocean waters of the Atlantic Ocean westward of 73 degrees 30 minutes west longitude and northward of 40 degrees 10 minutes north latitude.

EPA regulations implementing section 301(h) provide that a 301(h) modified NPDES permit may not be issued in violation of 40 CFR 125.59(b), which requires among other things, compliance with the provisions of the Coastal Zone Management Act (16 U.S.C. 1451 et seq.), the Endangered Species Act (16 U.S.C. 1531 et seq.), the Marine Protection, Research, and Sanctuaries Act (16 U.S.C. 1431 et seq.), and all other applicable provisions of State or Federal law or Executive Order. In the following discussion, EPA analyzes data submitted by the applicant in the context of the statutory and regulatory criteria.

SUMMARY OF FINDINGS

Based upon review of the data, references, and empirical evidence furnished in the application and other relevant sources, EPA Region IX makes the following findings with regard to the statutory and regulatory criteria:

1. The applicant's proposed discharge will comply with federal primary treatment requirements. [CWA section 301(h)(9); 40 CFR 125.60]

2. The applicant's proposed 301(h)-modified discharge will comply with the State of California's water quality standards for natural light, dissolved oxygen, and pH. The applicant sent a letter to the California Regional Water Quality Control Board, Central Coast (Regional Board) requesting determination that the proposed discharge complies with applicable State law including water quality standards. In 1984, a Memorandum of Understanding was signed by EPA Region IX and the State of California to jointly administer discharges that are granted modifications from secondary treatment standards. The joint issuance of a NPDES permit which incorporates both the federal 301(h) variance and State permit requirements will serve as the State's certification/concurrence that the modified discharge will comply with applicable State law and water quality standards. A draft 301(h)-modified permit has been jointly developed by the Regional Board and EPA Region IX. [CWA section 301(h)(1); 40 CFR 125.61]

3. The applicant demonstrated it can consistently achieve State water quality standards and federal 304(a)(1) water quality criteria beyond the zone of initial dilution. [CWA section 301(h)(9); 40 CFR 125.62(a)]

4. The applicant's proposed discharge, alone or in combination with pollutants from other sources, will not adversely impact public water supplies or interfere with the protection and propagation of a balanced,

indigenous population of fish, shellfish and wildlife, and will allow for recreational activities. [CWA section 301(h)(2); 40 CFR 125.62(b), (c), (d)]

5. The applicant has a well-established monitoring program and has demonstrated it has adequate resources to continue the program. EPA Region IX and the Regional Board will review the applicant's existing monitoring program and revise it, as appropriate. These revisions will be included in the 301(h)-modified permit, as conditions for monitoring the impact of the discharge. [CWA section 301(h)(3); 40 CFR 125.63]
6. The applicant sent a letter to the Regional Board requesting determination that the proposed discharge will not result in any additional treatment requirements on any other point or non-point sources. The adoption by the Regional Board of a NPDES permit which incorporates both the federal 301(h) variance and State permit requirements will serve as the State's determination, pursuant to 40 CFR 125.59(f)(4), that the requirements under 40 CFR 125.64 are achieved. [CWA section 301(h)(4); 40 CFR 125.64]
7. The applicant has an approved pretreatment program, in effect since 1983. [CWA section 301(h)(5); 40 CFR 125.66 and 125.68]
8. The applicant complies with urban area pretreatment requirements by establishing applicable local limits for each toxic pollutant introduced by an industrial discharger and using appropriate enforcement tools. [CWA section 301(h)(6); 40 CFR 125.65]
9. The applicant has a nonindustrial source control program, in effect since 1986, to characterize pollutants from residential areas and an existing public education program encouraging waste minimization and source reduction to limit the amount of toxic pollutants that enter the treatment system. [CWA section 301(h)(7); 40 CFR 125.66]
10. There will be no new or substantially increased discharges from the point source of the pollutants to which the 301(h) variance applies above those specified in the permit. [CWA section 301(h)(8); 40 CFR 125.67]
11. The applicant sent letters to the U.S. Fish and Wildlife Service, the NOAA National Marine Fisheries Service, and the California Coastal Commission requesting determinations that the proposed discharge complies with applicable federal and State laws. The issuance of a final 301(h)-modified permit is contingent upon receipt of determinations that the issuance of such permit does not conflict with applicable provisions of federal and State laws. [40 CFR 125.59]

CONCLUSION

EPA concludes the applicant's proposed discharge will comply with the requirements of CWA section 301(h) and 40 CFR 125, Subpart G.

RECOMMENDATION

EPA recommends the applicant be allowed to retain the 301(h) variance in accordance with the above findings, contingent upon the satisfaction of the following conditions:

1. The determination by the Regional Board that the proposed discharge will comply with applicable provisions of State law, including water quality standards, in accordance with 40 CFR 125.61(b)(2). The adoption by the Regional Board of a NPDES permit which incorporates both the federal 301(h) variance and State permit requirements will serve as the State's certification/concurrence, pursuant to 40 CFR Parts 124.53 and 124.54, that requirements under 40 CFR 125.61(b)(2) are achieved.
2. The determination by the Regional Board that the proposed discharge will not result in any additional treatment requirements on any other point or non-point sources, in accordance with 40 CFR 125.64. The adoption by the Regional Board of a NPDES permit which incorporates both the federal 301(h) variance and State permit requirements will serve as the State's determination, pursuant to 40 CFR 125.59(f)(4), that requirements under 40 CFR 125.64 are achieved.
3. The draft permit contains the applicable terms and conditions required by 40 CFR 125.68, for establishment of a monitoring program.
4. The determination by the California Coastal Commission that issuance of a 301(h)-modified permit does not conflict with the Coastal Zone Management Act, as amended.
5. The determination by the U.S. Fish and Wildlife Service that issuance of a 301(h)-modified permit does not conflict with applicable provisions of the federal Endangered Species Act, as amended.
6. The determination by the NOAA National Marine Fisheries Service that issuance of a 301(h)-modified permit does not conflict with applicable provisions of the federal Endangered Species Act, as amended, and the Magnuson-Stevens Fishery Conservation and Management Act, as amended.
7. Issuance of the 301(h)-modified permit assures compliance with all applicable requirements of 40 CFR 122 and 40 CFR 125, Subpart G.

DESCRIPTION OF TREATMENT SYSTEM

The Goleta Wastewater Treatment Plant (the plant) is located approximately 10 miles west of the City of Santa Barbara and treats wastewater from the Goleta Sanitary District, the Goleta West Sanitary District, the University of California Santa Barbara, the Santa Barbara Municipal Airport and other facilities in Santa Barbara County. Goleta's service area involves over 190 miles of pipeline, which collect wastewater at each participating agency's gravity-fed pump station, where it is then transferred to the plant. The plant is designed to accommodate an average dry-weather flow of 9.0 MGD and a peak wet-weather flow of 25.4 MGD. According to the applicant, the actual annual average flow in

2008 was 5.0 MGD. The plant's 43 industrial users generate approximately 4% of the current flow.

At the plant headworks, raw wastewater (influent) flows through a bar screen, which removes large debris. The wastewater is then routed to aerated grit tanks, where sand and grit settle out. Water from these tanks flows to three primary sedimentation basins, where settling solids and floatable materials are collected and sent to digesters. The primary effluent is then split with one portion receiving secondary treatment and the other portion routed directly to disinfection. Secondary treatment consists of a biofilter, a solids contact channel (for air injection and reintroduction of recirculated sludge) and secondary sedimentation tanks. A portion of the secondary flow is diverted to the water reclamation facility. The remaining secondary flow is combined with the primary flow where it is chlorinated in the chlorine contact channel by sodium hypochlorite and dechlorinated by sodium bisulfite before discharge to the ocean.

The disinfected effluent discharges to the Pacific Ocean through a 5,912-foot outfall pipe, which terminates in a 280-foot long multiport (34-port) diffuser at an average depth of 87 feet. The diffuser coordinates are Latitude 34° 24' 06" N and Longitude 119° 49' 27" W. The 4-inch-in-diameter ports are located on alternate sides of the diffuser and vary in depth from 74 to 92 feet below the mean lower low water surface.

Sludge is treated through anaerobic digestion for approximately 55 days and sent to stabilization basins for 2 years. The stabilized sludge is dewatered by drying bed or belt press and then made available, as Class A biosolids, to the local community as a soil amendment. All debris and grit from the primary treatment process are trucked to a landfill for disposal.

The plant is permitted by the Regional Board (Order No. 91-03) to produce up to 3.0 MGD of reclaimed water. A portion of the secondary effluent enters the reclamation facilities where it is mixed with aluminum sulfate and polymer and filtered through a bed of anthracite coal to remove floc. The filtered water is then disinfected with sodium hypochlorite and stored in an underground storage tank until needed. This water is distributed for landscape irrigation and dust control.

DESCRIPTION OF RECEIVING WATERS

Currents

The plant's outfall is located southeast of Point Conception and northwest of the City of Santa Barbara on the California Central Coast. The predominant oceanic surface flow along the coast is due to the southward flowing California current. As this current passes Point Conception, the abrupt change in coastline direction causes a large-scale eddy to form south of Point Conception within the Santa Barbara Channel. This eddy circulates counterclockwise between the mainland and offshore Channel Islands. Consequently, a prevailing westward ocean current in the Goleta-Santa Barbara area is observed during most of the year.

The applicant measured current transport at 6-meter and 19-meter depths near the outfall and recorded 3-minute and 1-minute averages over the permit term. In 2008, currents moved in a southwest to westerly direction with average speeds ranging between 7.09 cm/s in winter to 10.70 cm/s in summer at the 6-meter depth, and between 6.19 cm/s in

winter to 8.86 cm/s in summer at the 19-meter depth. Current measurements from 2006 and 2007 were similar to those measured in 2008. According to the applicant, currents at the 19-meter depth were more variable and more often turbulent with a slight offshore component.

The applicant also calculated the lowest 10^{th}-percentile current speeds from measurements obtained at current meters located 300 meters east of the outfall. The results ranged from 1.41 to 4.39 cm/s. The applicant did not observe a seasonal trend in the 10^{th}-percentile, median, or mode current speeds.

To determine the potential for wind-induced natural upwelling near the outfall, the applicant analyzed wind direction and frequency. Upwelling events can increase the buoyancy of the outfall plume, involving water at the level of the diffuser and a few meters above. The analysis found the predominant northwesterly winds do not support perennial upwelling as they blow parallel to the coast for only a few hours a day; however, temporary local wind conditions may occasionally create mild upwelling.

Stratification

The applicant computed density profiles from temperature and salinity data measured during quarterly surveys over the permit term at monitoring station B4 (near the outfall terminus) and station B6 (3,000 meters east of the outfall). Density profiles were similar at both stations, with higher water column density stratification occurring during July and October.

The formation of a thermocline at a depth of 10-15 meters (or 33-49 feet) caused strong stratification during the month of July. Temperatures during this month, measured at K (nearshore) and B (ocean) monitoring stations, ranged from 13° C near the bottom to 18° C at the surface; however, the water column was isothermal during the winter and spring. The applicant performed a statistical t-test, which found no significant differences between temperatures at the outfall and temperatures at the farfield stations. Overall, the lowest temperatures occurred in April and the highest occurred in July.

Salinity, affected by seasonal currents and upwelling, was fairly stable over the permit term, ranging from 33.4 parts per trillion (ppt) in October to 33.9 ppt in April. Similar to temperature, the water column was isohaline in January.

PHYSICAL CHARACTERISTICS OF THE DISCHARGE

Outfall/Diffuser and Initial Dilution

Under 40 CFR 125.62(a), the applicant's proposed outfall and diffuser must be located and designed to provide adequate initial dilution, dispersion, and transport of wastewater to meet all applicable water quality standards and criteria at and beyond the boundary of the zone of initial dilution (ZID). This evaluation is based on conditions occurring during periods of maximum stratification and during other periods when discharge characteristics, water quality, biological seasons, or oceanographic conditions indicate more critical situations exist.

The outfall/diffuser system and design capacity of the plant have not changed, so the applicant cited the same initial dilutions previously determined in the 1993 Tetra Tech

Technical Review of Goleta's previous 301(h) application (TTR). The TTR determined a critical initial dilution of 55:1 and a minimum monthly initial dilution of 122:1 using the UDKHDEN model. The critical initial dilution of 55:1 is based on a peak dry-weather flow of 16.93 MGD and a peak wet-weather flow of 22.02 MGD and is used to assess worst-case conditions and discharge compliance with Federal acute and chronic water quality criteria for aquatic life. The minimum monthly initial dilution of 122:1 is based on a monthly average flow of 7.2 MGD and is used to assess compliance with California Ocean Plan (COP) Table B water quality objectives. The COP includes State water quality objectives applicable to Goleta's discharge. Chapter III of the COP requires that "Waste effluents shall be discharged in a manner which provides sufficient initial dilution to minimize the concentrations of substances not removed in the treatment." This plan defines the "minimum initial dilution (Dm)" as the "... lowest average initial dilution within any single month of the year," and specifies that "dilution estimates shall be based on observed waste flow characteristics, observed receiving water density structure, and the assumption that no currents, of sufficient strength to influence the initial dilution process, flow across the discharge structure" (State Water Resources Control Board, 2005). The TTR also determined a long-term average initial dilution of 170:1 using the model ULINE, to assess compliance with Federal water quality criteria for human health (organisms only).

EPA's 2002 Tentative Decision Document (TDD) regarding Goleta's 2001 301(h) application used a recalculated initial dilution of 111:1 to assess compliance with the COP. This revised initial dilution, calculated by the EPA PLUMES model, was based on a 9.0 MGD average design flow; however, the 2004 NPDES permit limits the effluent daily dry-weather flow to 7.64 MGD on a monthly average. Assuming no current, an effluent flow of 7.64 MGD corresponds to an initial dilution of 122:1. This initial dilution was incorporated into the effluent limits for toxics in the 2004 NPDES permit.

According to the applicant, the dry-weather season is June through September. Over the last permit term, actual dry-weather effluent flows at the plant were much lower than the 7.64 MGD permit limit. The highest daily maximum flow was 4.86 MGD and the highest monthly average flow was 3.09 MGD. For the wet-weather season, the highest daily maximum was 14.24 MGD and the highest monthly average was 4.62 MGD, which are significantly lower than both the design peak wet-weather flow and the flow used in calculating critical initial dilution.

In the 2009 application, Goleta projects an increase in influent flow from the past permit term annual average of 5.62 MGD to 5.81 MGD in 2013 and 6.00 MGD in 2018. These projections are based on historical flow increases, which result in higher flows than population-based projections. Goleta expects effluent flow to increase slightly from the past permit term annual average of 4.73 MGD to 4.79 MGD in 2013 and then decrease to 4.73 MGD in 2018. The change between influent and effluent flow projections is due to the projected increase in demand of reclaimed water, which should reach an annual average of 1.27 MGD and a monthly maximum of 2.83 MGD in 2018.

Application of Initial Dilution to Water Quality Standards

Based on the information summarized in the previous section, EPA concludes: (1) the outfall and diffuser system are well designed and achieve a high degree of dilution;

(2) the minimum monthly average initial dilution of 122:1 provides a conservative estimate of initial dilution for evaluating compliance with applicable State water quality standards in Table B of the COP; (3) the critical initial dilution of 55:1 is sufficiently conservative for evaluating compliance with EPA toxics water quality criteria for aquatic life; and (4) the long-term effective dilution of 170:1 provides an appropriate estimate for evaluating compliance with EPA toxics water quality criteria for human health (organisms only) based on long-term exposure. As in the 2002 TDD, this evaluation also uses the initial dilution value of 55:1 to assess worst-case conditions for suspended solids and dissolved oxygen concentrations following initial dilution.

Zone of Initial Dilution

Goleta did not make any changes to the outfall that would affect the dimensions of the ZID. The TTR calculated the dimensions of the ZID using procedures outlined in the 1982 Section 301(h) Technical Support Document. These procedures did not change when this document was amended in 1994 (Amended Technical Support Document, or ATSD). The dimensions of the ZID were estimated to be 138 m (453 ft) long and 54 m (177 ft) wide. Monitoring stations B4 and B5 are located 25 meters from the outfall and are considered ZID boundary stations.

Dilution Water Recirculation

Under CWA section 301(h)(9), modified discharges are prohibited into waters that contain significant amounts of previously discharged effluent from the treatment works. Re-entrainment of discharged effluent decreases the initial dilutions within the ZID and decreases the probability of the effluent to meet water quality standards at the edge of the ZID. Results of a dye study, summarized in the TTR, showed re-entrainment of previously discharged wastewater is probable during current reversals caused by tidal forces, but would not be expected to have a significant impact on dilution of the effluent plume.

APPLICATION OF STATUTORY AND REGULATORY CRITERIA

A. Compliance with Federal Primary Treatment & California Ocean Plan Table A Requirements

The applicant is required under CWA section 301(h)(9) and 40 CFR 125.60 to demonstrate, at the time the 301(h) variance becomes effective, it will be discharging effluent that has received at least primary or equivalent treatment. According to 40 CFR 125.58(r), primary treatment means treatment by screening, sedimentation, and skimming adequate to remove at least 30 percent of the biological oxygen demanding material and of the suspended solids in the treatment plant influent, and disinfection, where appropriate.

Table A of the California Ocean Plan (COP) requires publicly owned treatment works to, as a 30-day average, remove 75 percent of suspended solids from the influent stream before discharging wastewater to the ocean. Table A also specifies effluent turbidity must not exceed 75 Nephelometric Turbidity Units (NTU) as a 30-day average, 100 NTU as a 7-day average, and 225 NTU at any time. Effluent settleable solids must not exceed 1.0 mL/L as a 30-day average, 1.5 mL/L as a 7-day average, and 3.0 mL/L at any time. There

are no Table A effluent requirements for biochemical oxygen demand. EPA discusses compliance with COP water quality objectives for light transmittance and dissolved oxygen below, in sections B.1 and B.2.

1. Total Suspended Solids

In order to comply with federal primary treatment and COP requirements, the applicant proposes renewal of the following effluent limits for total suspended solids as established in the existing permit:

TSS: (1) The 30-day average shall not exceed 63 mg/l.
(2) The maximum at any time shall not exceed 100 mg/l.
(3) The 30-day average percent removal shall not be less than 75%.

Under the existing permit, Goleta takes 24-hour composite samples of the plant influent and effluent five days per week and analyzes them for total suspended solids. Additionally, Goleta takes grab samples of the effluent five days per week and analyzes them for settleable solids and turbidity. EPA reviewed influent and effluent monitoring data reported over the permit term in monthly discharge monitoring reports. Discharge monitoring data for suspended solids, turbidity, and settleable solids is summarized in the following tables.

Table 1. Monthly average and annual average influent concentrations for total suspended solids (mg/l) at Goleta Sanitary District.

Month	**2005**	**2006**	**2007**	**2008**	**2009**
January	254	278	360	285	245
February	244	286	324	306	270
March	223	302	331	274	281
April	287	341	293	291	293
May	245	396	328	257	287
June	237	391	279	266	276
July	227	287	267	270	287
August	241	318	285	241	255
September	259	300	281	259	269
October	277	299	326	255	--[1]
November	289	327	354	247	--
December	321	329	329	238	--
Annual Average	259	321	313	266	274
Maximum Month	321	396	360	306	293
Minimum Month	223	278	267	238	245

[1]Data not available at time of analysis.

Table 2. Monthly average and annual average effluent concentrations for total suspended solids (mg/l) at Goleta Sanitary District.

Month	2005	2006	2007	2008	2009
January	40.7	30.7	39.8	39.2	36.8
February	40.0	38.3	40.7	37.6	42.6
March	38.0	27.9	45.0	43.0	37.8
April	42.0	35.9	39.9	49.6	44.2
May	41.9	31.4	44.3	41.1	40.7
June	41.7	36.2	47.3	41.1	44.4
July	43.4	31.9	38.2	36.4	36.5
August	34.6	35.0	39.6	31.7	33.7
September	36.3	36.7	36.2	35.4	30.9
October	31.9	34.6	34.4	40.0	--
November	30.2	31.8	35.1	33.0	--
December	28.1	32.2	29.7	31.6	--
Annual Average	37.4	33.6	39.2	38.3	38.6
Maximum Month	43.4	38.3	47.3	49.6	44.4
Minimum Month	28.1	27.9	29.7	31.6	30.9

Table 3. Monthly average and annual average percent removals for total suspended solids (%) at Goleta Sanitary District.

Month	2005	2006	2007	2008	2009
January	83.5	89.0	88.0	85.0	85.0
February	82.0	86.0	87.0	87.0	84.0
March	82.0	90.0	86.0	84.0	86.0
April	85.0	88.0	86.0	83.0	84.0
May	82.5	92.0	86.0	84.0	86.0
June	82.0	90.0	83.0	84.0	83.0
July	79.0	89.0	85.0	86.0	87.0
August	85.0	88.0	86.0	86.0	86.0
September	86.0	87.0	87.0	86.0	88.0
October	88.0	88.0	89.0	84.0	--
November	88.0	90.0	90.0	86.0	--
December	91.0	90.0	90.0	86.0	--
Annual Average	84.5	88.9	86.9	85.1	85.4
Maximum Month	91.0	92.0	90.0	87.0	88.0
Minimum Month	79.0	86.0	83.0	83.0	83.0

Table 4. Monthly average and annual average effluent values for turbidity (NTU) at Goleta Sanitary District.

Month	2005	2006	2007	2008	2009
January	42	40	44	44	51
February	45	46	47	43	50
March	41	40	50	48	48
April	46	44	48	56	54
May	51	42	51	55	58
June	53	48	51	54	61
July	51	41	49	52	49
August	45	46	51	44	48
September	46	50	51	45	48
October	42	44	49	51	--
November	41	46	46	51	--
December	38	44	42	46	--
Annual Average	45	44	48	49	52
Maximum Month	53	50	51	56	61
Minimum Month	38	40	42	43	48

Table 5. Monthly average and annual average effluent concentrations for settleable solids (ml/l) at Goleta Sanitary District.

Month	2005	2006	2007	2008	2009
January	0.2	0.2	0.1	0.2	0.2
February	0.3	0.2	0.1	0.3	0.2
March	0.2	0.2	0.1	0.2	0.2
April	0.2	0.2	0.2	0.3	0.2
May	0.2	0.3	0.2	0.2	0.2
June	0.2	0.3	0.3	0.2	0.2
July	0.2	0.3	0.2	0.3	0.2
August	0.2	0.3	0.3	0.3	0.2
September	0.2	0.2	0.3	0.2	0.2
October	0.2	0.2	0.3	0.3	--
November	0.2	0.2	0.3	0.2	--
December	0.2	0.1	0.2	0.2	--
Annual Average	0.2	0.2	0.2	0.2	0.2
Maximum Month	0.3	0.3	0.3	0.3	0.2
Minimum Month	0.2	0.1	0.1	0.2	0.2

Table 3 shows the plant's monthly average percent removals of total suspended solids ranged from 79.0% to 92.0% over the permit term, consistently meeting both the federal primary treatment requirement of at least 30% removal and the COP Table A requirement of at least 75% removal. Table 2 shows the highest monthly average effluent concentration of total suspended solids was 49.6 mg/l, which meets the applicant's proposed monthly average effluent limit of 63 mg/l.

EPA's review of monitoring data found both turbidity and settleable solids concentrations in the plant effluent met COP Table A requirements, which are also established as permit limits in the existing permit. Tables 4 and 5 summarize the turbidity and settleable solids monthly average effluent concentrations for the last permit term. The applicant met both the monthly average and weekly average requirements for turbidity 100% of the time, and the instantaneous requirement 99.9% of the time; the difference is due to one exceedance out of more than 1,000 samples. The applicant consistently met the monthly average, weekly average, and instantaneous maximum requirements for settleable solids.

2. Biochemical Oxygen Demand

In order to comply with federal primary treatment requirements for biochemical oxygen demand, the applicant proposes the renewal of the following effluent limits as established in the existing permit:

BOD: (1) The 30-day average shall not exceed 98 mg/l.
(2) The maximum at any time shall not exceed 150 mg/l.

Under the existing permit, Goleta takes 24-hour composite samples of the plant influent three days per week and the plant effluent five days per week to analyze for biochemical oxygen demand. EPA reviewed influent and effluent monitoring data reported over the permit term in monthly discharge monitoring reports. Discharge monitoring data for biochemical oxygen demand is summarized in the following tables.

Table 6. Monthly average and annual average influent concentrations for biochemical oxygen demand (mg/l) at Goleta Sanitary District.

Month	**2005**	**2006**	**2007**	**2008**	**2009**
January	205	265	283	251	257
February	215	314	302	261	263
March	210	292	280	273	283
April	233	276	291	269	310
May	220	293	319	259	298
June	208	284	301	280	265
July	218	271	282	270	291
August	207	290	267	251	268
September	238	273	255	284	284
October	283	282	313	294	--[1]
November	293	307	328	292	--
December	279	291	321	254	--

Month	2005	2006	2007	2008	2009
Annual Average	234	287	295	270	280
Maximum Month	293	314	328	294	310
Minimum Month	205	265	255	251	257

[1]Data not available at time of analysis.

Table 7. Monthly average and annual average effluent concentrations for biochemical oxygen demand (mg/l) at Goleta Sanitary District.

Month	2005	2006	2007	2008	2009
January	60.0	54.0	68.0	53.0	75.0
February	62.0	61.0	67.0	49.0	66.0
March	53.0	54.0	78.0	64.0	71.0
April	71.0	59.0	67.0	82.0	84.0
May	66.0	54.0	70.0	80.0	74.0
June	64.0	64.0	75.0	67.0	74.0
July	65.0	58.0	69.0	58.0	67.0
August	53.0	39.0	68.0	48.0	60.0
September	56.0	65.0	72.0	62.0	60.0
October	64.0	69.0	69.0	75.0	--
November	48.0	58.0	56.0	64.0	--
December	45.0	48.0	47.0	63.0	--
Annual Average	58.9	56.9	67.2	63.8	70.1
Maximum Month	71.0	69.0	78.0	82.0	84.0
Minimum Month	45.0	39.0	47.0	48.0	60.0

Table 8. Monthly average and annual average percent removals for biochemical oxygen demand (%) at Goleta Sanitary District.

Month	2005	2006	2007	2008	2009
January	69.9	80.0	76.0	78.0	70.0
February	71.0	80.0	77.0	81.0	73.0
March	73.0	81.0	72.0	77.0	75.0
April	69.0	78.0	77.0	68.0	72.0
May	69.0	81.0	78.0	69.0	75.0
June	69.0	78.0	75.0	76.0	72.0
July	69.0	78.0	75.0	78.0	76.0
August	74.0	78.0	75.0	80.0	78.0
September	76.0	76.0	71.0	78.0	79.0
October	77.0	76.0	77.0	74.0	--
November	83.0	81.0	86.0	78.0	--
December	84.0	84.0	85.0	75.0	--
Annual Average	73.7	79.3	77.0	76.0	74.4

Month	2005	2006	2007	2008	2009
Maximum Month	84.0	84.0	86.0	81.0	79.0
Minimum Month	69.0	76.0	71.0	68.0	70.0

Monthly average percent removals of biochemical oxygen demand shown in Table 8 ranged from 68.0 % to 86.0% over the permit term, meeting the federal primary treatment and existing permit requirements of at least 30% removal. The highest monthly average effluent concentration of 84 mg/l, shown in Table 7, meets the applicant's proposed monthly average effluent limit of 98 mg/l. The applicant met the instantaneous maximum permit limit 99.9% of the time; the difference is due to one exceedance out of more than 1,000 samples.

B. Attainment of Water Quality Standards for TSS and BOD

Section 301(h)(1) of the CWA, implemented by 40 CFR 125.61(a), requires the existence of water quality standards applicable to the pollutants for which a section 301(h) modified permit is requested, including: (1) water quality standards for biochemical oxygen demand or dissolved oxygen; (2) water quality standards for suspended solids, turbidity, light transmittance, light scattering, or maintenance of the euphotic zone; and (3) water quality standards for pH. Under 40 CFR 125.61(b)(1), the applicant must demonstrate the proposed modified discharge will comply with these standards. State water quality standards applicable to the Goleta discharge are specified in the California Ocean Plan (COP). The applicant did not request a modification for pH, so it is discussed under section C.1. Attainment of Other Water Quality Standards and Criteria.

1. Natural Light

The applicant requests modified effluent limits for total suspended solids. Increased total suspended solids concentrations associated with municipal discharges can cause a decrease in light penetration in the water column. Chapter II of the COP requires "natural light shall not be significantly reduced at any point outside the initial dilution zone as the result of the discharge of waste." Under the existing permit, Goleta collects light transmittance data at both offshore and down-plume monitoring stations and reports the results at 1-meter depth intervals from 1 to 30 meters. EPA reviewed quarterly light transmittance profiles over the permit term and compared the light transmittance at the zone of initial dilution (plume station WC-ZID) with the light transmittance at offshore stations B1 through B6. Station WC-ZID is located 25 meters from the outfall in the direction of the wastewater plume. Stations B1 through B6 are located between 1,500 meters west of the outfall to 3,000 meters east of the outfall. A map of receiving water monitoring stations, Figure IIB-1 of the application, is attached in Appendix A. Table 9 shows the percent reduction in light transmittance at station WC-ZID compared to offshore stations, averaged over all depths.

Table 9. Percent reduction in light transmittance at station WC-ZID, relative to offshore stations. (Negative values indicate light transmittance at station WC-ZID is higher than at other stations).

Quarter	WC-ZID vs BI	WC-ZID vs B2	WC-ZID vs B3	WC-ZID vs B4	WC-ZID vs B5	WC-ZID vs B6
January 2005	59%	33%	-10%	-274%	35%	35%
April 2005	3%	1%	1%	1%	1%	1%
July 2005	0%	0%	0%	0%	0%	3%
October 2005	0%	0%	1%	1%	1%	-1%
January 2006	4%	-5%	-3%	4%	1%	-7%
April 2006	-5%	-5%	-3%	-4%	-3%	-4%
July 2006	2%	1%	1%	2%	0%	1%
October 2006	1%	1%	2%	1%	2%	1%
January 2007	4%	-1%	-4%	0%	1%	-1%
April 2007	0%	-2%	-5%	1%	-5%	-5%
July 2007	-1%	1%	1%	1%	0%	1%
October 2007	1%	1%	1%	1%	-2%	1%
January 2008	1%	1%	1%	1%	1%	-4%
April 2008	-3%	-1%	5%	4%	3%	6%
July 2008	0%	0%	0%	-1%	-1%	-1%
October 2008	3%	2%	2%	0%	2%	1%

Except for January 2005, light transmittance at station WC-ZID is not significantly different and sometimes measures slightly higher than at offshore stations. The National Oceanic and Atmospheric Administration recorded historically heavy rainfall in Santa Barbara County in January 2005 (NOAA, 2009), which may explain the large differences and variability in light transmittance between stations for the month. Disregarding the January 2005 results, the highest reduction in light transmittance (6%) occurred in April 2008. Six percent reduction is small compared to the natural variability in the Southern California Bight. In 1994, researchers found 30% variability in surface light transmittance and 55% variability in bottom light transmittance in a survey of 261 sites along the southern California coastal shelf (Santangelo, R.V., 1994).

The percent removals of total suspended solids in Goleta effluent in January 2005 and April 2008 were 83.5% and 83.0%, respectively. Both meet the COP discharge requirement of 75%, which is also the existing permit limit. Additionally, the monthly average TSS effluent concentrations in January 2005 and April 2008 were 40.7 mg/l and 49.6 mg/l, respectively. These concentrations are similar to concentrations measured throughout the permit term and also meet the existing permit limit. EPA concludes the outfall is not significantly affecting the ambient light transmittance and the discharge meets the requirements of the COP.

2. Dissolved Oxygen

The applicant also requests modified effluent limits for biochemical oxygen demand, which can affect the ambient dissolved oxygen concentration. Chapter II of the COP requires "the dissolved oxygen concentration shall not be depressed more than 10 percent

from that which occurs naturally, as the result of the discharge of oxygen demanding waste materials."

Both the applicant and EPA modeled the potential for: (1) dissolved oxygen depression following initial dilution during the period of maximum stratification (or other critical period); (2) farfield dissolved oxygen depression associated with biochemical oxygen demand exertion in the wastefield; (3) dissolved oxygen depression associated with steady-state sediment oxygen demand; and (4) dissolved oxygen depression associated with the resuspension of sediments. EPA discusses each evaluation in the following paragraphs and Table 10 summarizes the results.

a. Dissolved Oxygen Depression upon Initial Dilution

Using the method described in the 1994 Amended Section 301(h) Technical Support Document (ATSD), the applicant predicted a dissolved oxygen depression following initial dilution of 0.07 mg/l, assuming an immediate dissolved oxygen demand (IDOD) of 2 mg/l, initial dilution of 137:1, ambient dissolved oxygen concentration of 7.8 mg/l and effluent dissolved oxygen concentration of 0 mg/l. The applicant produced the 137:1 initial dilution with the PLUMES model, assuming ambient density, thermocline stratification, and no current. The predicted final dissolved oxygen concentration after initial dilution was 7.73 mg/l, which means a 0.07 mg/l or 0.9% reduction in dissolved oxygen.

EPA recalculated this depression for both the critical initial dilution of 55:1 and the 122:1 dilution used for COP compliance, as well as a range of ambient dissolved oxygen concentrations (4 – 9 mg/l). EPA assumed an IDOD of 2 mg/l and an effluent concentration of 0 mg/l. With an initial dilution of 122:1, the predicted dissolved oxygen depression following initial dilution was 0.09 mg/l or a 1% reduction in dissolved oxygen. For the critical initial dilution of 55:1, the predicted dissolved oxygen depression following initial dilution was 0.20 mg/l or a 2% reduction in dissolved oxygen. Thus, even under the worst-case conditions, the maximum predicted reduction in dissolved oxygen is less than 3%.

b. Dissolved Oxygen Depression due to BOD in the Farfield

After initial dilution, dissolved oxygen may be consumed by biochemical oxygen demand in the wastefield. The applicant evaluated whether the dissolved oxygen standard (DO_{STD}) is less than or equal to the dissolved oxygen concentration after initial dilution (DO_f) minus the biochemical oxygen demand after initial dilution (BOD_f) and multiplied by a factor of 1.46. This equation is presented in the ATSD:

$$DO_{STD} \leq DO_f - (BOD_f * 1.46)$$

The ATSD states that if the inequality is true, the discharge will not violate the dissolved oxygen standard due to BOD exertion and no further analysis is necessary. To evaluate this inequality, the applicant assumed a DO_{STD} of 7.0 mg/l, or 90% of the assumed ambient dissolved oxygen concentration (7.8 mg/l). The DO_f computed in the above section is 7.73 mg/l. The applicant calculated a 0.67 mg/l BOD_f, assuming an effluent BOD concentration of 62.7 mg/l, an initial dilution of 137:1, and an ambient BOD

concentration of 0 mg/l. Goleta applied the variables to the inequality yielding a value of 7.1 mg/l, which is greater than the DO_{STD}, thus the inequality is true.

EPA re-evaluated the inequality and found it to be true only at higher initial dilutions, such as the 137:1 dilution used by the applicant. The inequality was false for the critical initial dilution of 55:1 and the 122:1 dilution used for COP compliance.

Goleta conducted the entire analysis for the 1993 permit application and Tetra Tech did a recalculation for EPA in the 1993 Tetra Tech Technical Review (TTR). For the 1993 application, Goleta predicted a 0.03 mg/l depression due to BOD. The TTR used more conservative variables for the analysis, assuming a BOD effluent concentration of 98 mg/l, which corresponds to the modified permit limit, a critical initial dilution of 55:1, and an ambient dissolved oxygen concentration of 8.0 mg/l. The TTR predicted the dissolved oxygen depression due to BOD to be less than 0.01 mg/l. Assuming the 8.0 mg/l ambient concentration, 0.01 mg/l is equivalent to a dissolved oxygen depression of 0.13%, which is minimal when compared to the "no more than 10%" COP water quality objective.

c. Steady-State Sediment Oxygen Demand

The applicant calculated the steady-state sediment oxygen demand using the method described in the ATSD. Assumptions from the ATSD include an oxygen:sediment stoichiometric ratio (a) of 1.07 mg O_2/mg sediment and a sediment decay rate constant (k_d) of 0.01/day. Goleta also assumed a steady-state organic mass accumulation (S) of 30.6 g/m^2, a 1,560-meter length deposition area (X_M), and a minimum current speed of 2.3 cm/s. Both the organic mass accumulation and length of deposition come from results of the sediment deposition modeling discussed below, in section C.1.c. Goleta chose a dilution caused by horizontal entrainment of ambient water (D) of 3 based on Table B-5 of the ATSD, using a travel time of 3.3 hrs and an initial field width of 480 meters. The average depth of water column influenced by sediment oxygen demand (H) of 1.86 m was calculated with a vertical diffusion coefficient (ε_z) of 0.8 cm^2/s. Incorporating these variables into the method described in the ATSD, Goleta predicted an oxygen depletion due to steady-state sediment oxygen demand of 0.05 mg/l. Assuming that the dissolved oxygen is typically near 6 mg/l at the bottom of the water column, this equates to a dissolved oxygen reduction of less than 1%.

EPA recalculated the steady-state sediment oxygen demand, using the organic mass accumulation of 12.4 g/m^2 from EPA's re-evaluation of the sediment deposition modeling discussed below, in section C.1.c and a more conservative dilution of 1.5 based on Table B-5 of the ATSD. Incorporating these variables, EPA predicted a dissolved oxygen reduction of 0.04 mg/l. Based on these results, EPA finds Goleta's model overestimates the steady-state sediment oxygen demand.

d. Sediment Oxygen Demand due to Sediment Resuspension

Goleta calculated the sediment oxygen demand due to resuspension based on the method described in the ATSD. Assumptions from the ATSD include a decay rate of resuspended sediments (k_r) of 0.1/day, a dilution (D) of 1, and a vertical diffusion coefficient when resuspension is occurring (ε'_z) of 5 cm^2/s. The average concentration of resuspended organic sediment (S_r) of 18.2 g/m^2 is based on the 90-day organic mass accumulation

from the sediment deposition modeling. Goleta calculated the depth of the water column containing resuspended materials (H) and finally the oxygen depletion (ΔDO) for 3-hour increments (t) up to 24 hours. The oxygen depletion ranged from 0.06 mg/l at 3 hours to 0.17 mg/l at 24 hours, which, assuming an ambient dissolved oxygen concentration of 8 mg/l, equates to an oxygen reduction of less than 2%.

EPA recalculated the sediment oxygen demand due to resuspension, using the 90-day organic mass accumulation of 7.3 g/m^2 from EPA's re-evaluation of the sediment deposition modeling discussed below, in section C.1.c. EPA determined a dissolved oxygen reduction range of 0.03 mg/l at 3 hours to 0.07 mg/l at 24 hours. Based on these results, EPA finds Goleta's model overestimates the sediment oxygen demand due to sediment resuspension.

Table 10. Summary of worst-case dissolved oxygen depressions associated with the Goleta outfall.

Sources of potential Oxygen Demand	**Goleta (mg/l)**	**EPA (mg/l)**
Dissolved Oxygen Depression upon Initial Dilution[1]	0.07	0.20
Dissolved Oxygen Depression due to BOD in the Farfield[2]	0.03	0.01
Steady-State Sediment Oxygen Demand	0.05	0.04
Sediment Oxygen Demand due to Sediment Resuspension	0.06 to 0.17	0.03 to 0.07

[1] Goleta's model result is based on a dilution of 137:1, while EPA's result is based on the worst-case dilution of 55:1.

[2] Goleta's result is from 1990, while EPA's result is from 1993 and based on more conservative variables.

Based on the modeling performed by Goleta and EPA, it is unlikely the outfall will cause a dissolved oxygen depression of more than 10%. EPA also reviewed ambient dissolved oxygen concentrations monitored by Goleta over the permit term and these are discussed in the following section.

e. Dissolved Oxygen Monitoring

Under the existing permit, Goleta collects dissolved oxygen data at both offshore and down-plume monitoring stations and reports results at 1-meter depths from 1 to 30 meters. EPA reviewed quarterly dissolved oxygen profiles over the permit term and compared the concentrations at the zone of initial dilution (plume station WC-ZID) with those at offshore stations B1 through B6. Table 11 shows the percent reduction in dissolved oxygen at station WC-ZID compared to offshore stations, averaged over all depths.

Table 11. Percent reduction in dissolved oxygen at station WC-ZID, relative to offshore stations. (Negative values indicate dissolved oxygen at station WC-ZID is higher than at other stations).

Quarter	WC-ZID vs BI	WC-ZID vs B2	WC-ZID vs B3	WC-ZID vs B4	WC-ZID vs B5	WC-ZID vs B6
January 2005	7%	7%	7%	0%	7%	9%
April 2005	-4%	-2%	-2%	-3%	-3%	-4%
July 2005	1%	3%	3%	1%	2%	-18%
October 2005	4%	9%	8%	7%	4%	-23%
January 2006	9%	3%	3%	5%	3%	-6%
April 2006	8%	10%	10%	2%	11%	15%
July 2006	5%	-1%	-5%	-6%	-5%	-3%
October 2006	1%	2%	2%	1%	2%	-2%
January 2007	0%	-1%	-2%	-3%	-1%	1%
April 2007	-3%	-8%	-17%	-10%	-11%	2%
July 2007	-2%	4%	4%	4%	1%	-4%
October 2007	2%	3%	3%	2%	-2%	2%
January 2008	1%	1%	0%	-1%	-2%	-4%
April 2008	-1%	-9%	-19%	-13%	-7%	-12%
July 2008	0%	0%	-2%	-2%	1%	-3%
October 2008	3%	0%	4%	0%	0%	0%

Dissolved oxygen concentrations at station WC-ZID are not depressed more than 10% from offshore station concentrations, with the single exception of April 2006. The 78.0 % removal of biochemical oxygen demand in Goleta effluent during April 2006 meets the federal primary treatment requirement of 30%, which is also the existing permit limit. The monthly average BOD concentration in April 2006 of 59.0 mg/l is similar to concentrations measured throughout the permit term. Therefore, it is unlikely the Goleta outfall caused the reduction in dissolved oxygen concentration during April 2006.

Based on our review of the modeling and ambient monitoring of dissolved oxygen, EPA concludes the outfall is not affecting the ambient dissolved oxygen concentration and the discharge meets the requirements of the COP.

C. Attainment of Other Water Quality Standards and Impact of the Discharge on Public Water Supplies; Shellfish, Fish and Wildlife; and Recreation

Section 301(h)(2) of the CWA, implemented under 40 CFR 125.62, requires the modified discharge not interfere, either alone or in combination with pollutants from other sources, with the attainment or maintenance of water quality that assures protection of public water supplies; protection and propagation of a balanced indigenous population of shellfish, fish, and wildlife; and allows recreational activities in and on the water. In addition, section 301(h)(9) of the CWA, implemented under 40 CFR 125.62(a), requires the modified discharge meet all applicable EPA-approved State water quality standards and, where no such standards exist, EPA's 304(a)(1) aquatic life criteria for acute and chronic toxicity and human health criteria for carcinogens and noncarcinogens, after initial mixing in the waters surrounding or adjacent to the outfall.

1. Attainment of Other Water Quality Standards and Criteria

40 CFR 125.62(a) requires the applicant's outfall and diffuser to be located and designed to provide adequate initial dilution, dispersion, and transport of wastewater such that the discharge does not exceed, at and beyond the zone of initial dilution, all applicable State water quality standards. Where there are no such standards, the discharge must not exceed 304(a)(1) aquatic life and human health criteria. For this review, EPA analyzes the applicable water quality standards and criteria in three categories: pH, toxics and whole effluent toxicity, and sediment quality.

a. pH

Chapter II of the California Ocean Plan (COP) requires "the pH shall not be changed at any time more than 0.2 units from that which occurs naturally." Under the existing permit, Goleta collects pH data at both offshore and down-plume monitoring stations and reports results at 1-meter depths from 1 to 30 meters. EPA reviewed quarterly pH profiles over the permit term and compared the concentrations at the zone of initial dilution (plume station WC-ZID) with those at offshore stations B1 through B6. Table 12 shows the change in pH at station WC-ZID compared to offshore stations, averaged over all depths.

Table 12. Change in pH at station WC-ZID, relative to offshore stations. (Negative values indicate pH at station WC-ZID is lower than at other stations).

Quarter	WC-ZID vs BI	WC-ZID vs B2	WC-ZID vs B3	WC-ZID vs B4	WC-ZID vs B5	WC-ZID vs B6
January 2005	-0.02	-0.02	-0.02	0.01	-0.02	-0.01
April 2005	0.03	0.02	0.02	0.02	0.03	0.03
July 2005	-0.01	-0.02	-0.01	0.00	-0.02	0.06
October 2005	-0.01	-0.04	-0.03	-0.03	0.00	0.17
January 2006	-0.05	-0.01	-0.01	-0.03	-0.01	0.06
April 2006	-0.04	-0.06	-0.04	-0.02	-0.06	-0.09
July 2006	-0.04	0.00	0.02	0.02	0.02	0.02
October 2006	--[1]	--	--	--	--	--
January 2007	0.00	0.01	0.02	0.02	0.01	0.04
April 2007	0.04	0.06	0.09	0.06	0.07	0.00
July 2007	0.01	-0.02	-0.02	-0.02	-0.01	0.05
October 2007	-0.01	-0.02	-0.01	-0.01	0.02	-0.01
January 2008	0.00	-0.01	0.00	0.00	0.00	0.02
April 2008	-0.02	0.05	0.09	0.07	0.06	0.06
July 2008	0.01	0.00	0.00	0.01	-0.01	0.04
October 2008	-0.02	0.00	-0.01	0.00	0.00	0.02

[1] *No data was recorded at the WC-ZID station in October 2006, so no comparison was made.*

The differences in pH between station WC-ZID and offshore monitoring stations over the permit term do not exceed 0.2 standard units. Thus, the discharge meets the COP requirement for pH.

Goleta takes grab samples of the effluent five days per week to analyze for pH. EPA reviewed effluent monitoring data reported over the permit term in monthly discharge monitoring reports. The minimum pH was 6.9 units and the maximum pH was 7.8 units. These levels achieve the technology-based effluent limits required in both Table A of the COP and federal secondary treatment standards.

Based on the ambient and effluent monitoring data, EPA concludes the discharge will not change the ambient pH more than 0.2 standard units and the applicant meets both water quality standards and technology-based effluent limits for pH.

b. Toxics and Whole Effluent Toxicity

Under the existing permit, Goleta monitors the effluent for priority toxic pollutants and the COP Table B parameters for the protection of marine aquatic life and human health. All Table B parameters for the protection of marine aquatic life are monitored monthly, except selenium and cyanide are monitored annually, total chlorine residual is monitored continuously, and acute and chronic toxicity are monitored quarterly. All Table B parameters for the protection of human health (carcinogens and noncarcinogens) and all the remaining priority toxic pollutants are monitored annually.

EPA compiled the effluent toxics and whole effluent toxicity data for the last permit term, years 2005 through 2008, and compared the highest effluent concentration for each toxic directly to the applicable COP Table B objective and the applicable EPA CWA section 304(a)(1) water quality criterion. EPA conducted this screening to determine if the effluent caused any direct exceedances of water quality standards. EPA screened the highest daily maximum effluent concentration of each parameter against the applicable EPA 304(a)(1) criteria using the critical worst-case dilution of 55:1 for aquatic life criteria and the long-term average dilution of 170:1 for human health criteria. Both the highest 6-month median and highest daily maximum effluent concentrations for each parameter were screened against the applicable Table B objectives using a dilution of 122:1. EPA used the value of the method detection limit for the comparison when a parameter was reported as "nondetect" for the entire permit term.

For all parameters detected at least once in the effluent, EPA found only one parameter, total chlorine residual, to exceed water quality standards over the last permit term. One exceedance of the total chlorine residual instantaneous maximum Table B objective for the protection of aquatic life occurred in September 2007. A 14-minute partial failure of the probe at the front of the chlorine contact chamber caused the concentration of total chlorine residual to swell from < 0.1 mg/l to 13.0 mg/l and then return to < 0.1 mg/l. Goleta promptly replaced the probe.

EPA also reviewed the sensitivity of the method detection limits for the comparison to water quality standards. EPA found the method detection limits for benzidine, 3,3'-dichlorobenzidine, 1,2-diphenylhydrazine, hexachlorobenzene, aldrin, 4,4'-DDT, 4,4'-DDE, dieldrin, heptachlor, heptachlor epoxide, polychlorinated biphenyls (PCBs), toxaphene, and chlordane were not low enough to evaluate effluent quality in relation to water quality standards after initial dilution. EPA determined as of 2008, Goleta achieves method detection limits as sensitive as the minimum levels required by Appendix II of the COP for 4,4'-DDT, 4,4'-DDE, PCBs, and chlordane. The method detection limits for

benzidine, 3,3'-dichlorobenzidine, 1,2-diphenylhydrazine, hexachlorobenzene, aldrin dieldrin, heptachlor, heptachlor epoxide and toxaphene need to be lowered to achieve COP minimum levels. EPA found the 2008 method detection limit for 2,4-dinitrophenol adequate to evaluate water quality standards after initial dilution; however, it should also be lowered to meet the minimum level required by the COP.

Under the existing permit, Goleta conducts quarterly whole effluent toxicity (WET) tests. WET tests determine the aggregate toxic effect of pollutants within a discharger's effluent to aquatic organisms. Goleta uses the fathead minnow (*Pimphales promelas*) to test for acute toxicity and red abalone (*Haliotis rufescens*) to test for chronic toxicity. Over the last permit term, Goleta's effluent did not exceed Table B objectives for acute or chronic toxicity after initial dilution and has consistently met the limits imposed by the existing permit.

Based on this review, EPA concludes the modified discharge meets State water quality standards as required by 40 CFR 125.62(a).

c. Sediment Quality

The accumulation of solids in and beyond the vicinity of the discharge can adversely affect local biological communities. 40 CFR 125.62 requires that following initial dilution, the diluted wastewater and particulates must be transported and dispersed so water use areas and areas of biological sensitivity are not adversely affected. Chapter II of the COP requires "the rate of deposition of inert solids and the characteristics of inert solids in ocean sediments shall not be changed such that benthic communities are degraded."

Both organic and inorganic contaminants can accumulate in sediments. To address this contamination, Chapter II of the COP provides further narrative, requiring "the concentration of organic materials in marine sediments shall not be increased to levels that would degrade marine life," "nutrient materials shall not cause objectionable aquatic growths or degrade indigenous biota," and "the dissolved sulfide concentration of waters in and near sediments shall not be significantly increased above that present under natural conditions."

For the previous 301(h) waiver application, Goleta calculated suspended solids deposition rates for the modified discharge using both the simple method described in the ATSD and the EPA SEDDEP Model. The values and assumptions used in the previous modeling have not changed and are therefore valid for this TDD.

ATSD Sediment Deposition Model

For the ATSD method, Goleta assumed a total suspended solids concentration of 60 mg/l and a discharge flow of 7.7 MGD to calculate a mass emission rate of 1,737 kg/day. The 12-meter height-of-rise of the plume is the result of a PLUMES model simulation which calculated the initial dilution based on a discharge flow of 7.7 MGD. Goleta used current velocities of 9 cm/s upcoast (west), 4 cm/s downcoast (east), and 2 cm/s onshore and offshore, which are typical of the local currents. Particle settling velocities of 0.1, 0.01, 0.006, and 0.001 cm/s are listed in the ATSD for "primary or advanced primary effluent." Goleta assumed effluent solids were 80% organic, 50% of these solids would remain

suspended, and a decay rate constant of 0.01/day. This model assumes effluent sediment particles with a specific fall velocity settle uniformly within an elliptical area.

From these variables and assumptions, Goleta calculated the maximum settling distance from the outfall by particle settling rate, current velocity and direction. Assuming an elliptical area of deposition, area was calculated using the equation: area = π*length*width. For each particle settling rate, length is equal to the sum of upcoast and downcoast maximum settling distance and width is equal to the sum of onshore and offshore maximum settling distance. From this, Goleta determined mass deposition rates in $g/m^2/day$ and finally, the steady-state and critical 90-day accumulations in g/m^2. Table 13 provides a summary of the ATSD model results. The model predicts the highest organic mass deposition rate of 0.2954 $g/m^2/day$ occurs within 2.35 km^2 around the outfall. The predicted depositional pattern is a 1,560 m by 480 m ellipse.

Table 13. Summary of ATSD sediment deposition model results based on 7.7 MGD flow.

Particle Settling Velocity (cm/s)	Area of Deposition (km^2)	Organic Mass Deposition Rate ($g/m^2/day$)	Steady State Organic Accumulation (g/m^2)	Peak 90-Day Organic Accumulation (g/m^2)
0.1	2.35	0.2954	30.6	18.2
0.01	235	0.0089	1.1	0.7
0.006	652	0.0021	0.2	0.1
0.001	23,524	0.0001	0.01	0.01

Using the same variables, EPA recalculated the results of the ATSD model. EPA used the equation: π *(length/2)*(width/2), the area of an ellipse, in order to calculate the area of deposition. EPA's calculations resulted in an organic mass deposition rate of 0.1191 $g/m^2/day$, a steady-state organic accumulation of 12.4 g/m^2, and a peak 90-day organic accumulation of 7.3 g/m^2. Based on these results, EPA finds Goleta's model overestimates the organic accumulation.

SEDDEP Model

Goleta also calculated sediment deposition using the EPA model SEDDEP. This model incorporates more realistic particle distribution and allows for the use of additional current information and bathymetry. Goleta entered the same values for flow, suspended solids concentration, and height-of-rise of the plume as those used in the ATSD model. The SEDDEP model assumes currents representing the typical minimal flow from April through July. The results of this model were similar to those of the ATSD model. The model predicted a total deposition rate of 0.37 $g/m^2/day$. Eighty percent of this loading is assumed to be organic. The predicted elliptical deposition area is 1,067 m by 366 m. From the total deposition rate, Goleta estimated a carbon loading of 0.15 g $C/m^2/day$.

Researchers (Maughan and Oviatt, 1993) found alteration of the benthic community in response to the discharge of wastewater solids is related to the rate of organic carbon deposition. Little or no change to the benthic community occurs at deposition rates less than 0.1 g $C/m^2/day$. A changed benthic community, meaning an increase in biomass and abundance accompanied by a shift in dominant feeding type, is observed at deposition rates between 0.1 g $C/m^2/day$ and 1.0 g $C/m^2/day$. A degraded benthic community is

expected at deposition rates greater than 1.5 g C/m^2/day. Goleta's estimation of 0.15 g C/m^2/day falls just within the organic carbon deposition range for a "changed" benthic community, thus there is some enrichment, but the benthic community is not degraded. EPA's review of sediment monitoring data, discussed in the following sections, further evaluates whether significant accumulation is actually occurring in the area of the outfall.

Sediment Grain Size Characteristics

Physical sediment characteristics, such as particle size and percent fines, affect the biology and chemistry of the local environment. Finer sediments provide habitat for different benthos and infaunal organisms than rocky sediments, and also more easily adsorb contaminants. Goleta provided particle size distributions from offshore monitoring stations B1 through B6 for October 2004 through October 2008 annual surveys in Table IIC-1 of the application. The applicant reports the sediment is comprised of 69-89% sand, 13-34% silt, and 2-6% clay. Station B5, near the zone of initial dilution (near-ZID), has a higher range of percent fines than reference station B6; however, the range of percent fines at near-ZID station B4 is entirely within the range found at reference station B6.

Figure IIC-1 of the application shows the distribution of fine sediments over time by station. All stations, except for B3, show a pattern of increasing fines in October 2005, and then a steady decrease through October 2008. The applicant reports this pattern may be due to deposition of sediments during the historically high rain season of 2005.

Organic Indicators

EPA evaluated annual survey data for total organic carbon, total Kjeldahl nitrogen and acid volatile solids to determine whether the outfall is contributing to organic enrichment in ocean sediments.

Total Organic Carbon (TOC). Total organic carbon is a measurement of organic carbon in sediments. Figure 1 shows sediment concentrations of total organic carbon varied across monitoring stations. Over the permit term, mean concentrations of total organic carbon concentrations ranged from 3,760 µg/g at reference station B6 to 7,210 µg/g at station B1.

Total Kjeldahl Nitrogen (TKN). Total Kjeldahl nitrogen is the sum of organic nitrogen, ammonia (NH_3) and ammonium (NH_4^+). Figure 2 shows concentrations of total Kjeldahl nitrogen are fairly consistent across offshore monitoring stations but slightly lower at reference station B6. The mean total Kjeldahl nitrogen concentrations ranged from 338 µg/g at reference station B6 to 550 µg/g at station B2.

Acid Volatile Sulfides (AVS). Acid volatile sulfides have a strong effect on the bioavailability and toxicity of metals in sediments. Figure 3 shows concentrations of acid volatile sulfides varied considerably across monitoring stations and over time, with an unusually high peak at station B3 in 2005. Without taking into account this peak at B3, the mean acid volatile sulfide concentrations ranged from 5.57 µg/g at near-ZID station B5, to 8.12 µg/g at station B3.

In this review of sediment concentrations of organics over time, EPA found no obvious spatial or temporal pattern which would indicate a significant carbon, nutrient, or acid volatile sulfide contribution from the outfall.

Trace Metals and Toxic Organics

The COP requires "the concentration of substances set forth in Chapter II, Table B, in marine sediments shall not be increased to levels which would degrade indigenous biota." In order to evaluate the toxicity of pollutants in local sediments and determine whether the discharge from the Goleta outfall influences the accumulation of these pollutants, EPA evaluated sediment chemistry results from five years (2004-2008) of annual surveys performed during the month of October. In the application, Goleta provides sample results for fifteen trace metals and four complex organics in sediments at offshore monitoring stations B1 through B6. Stations B4 and B5 are located near the zone of initial dilution and station B6 is the reference station.

First, EPA evaluated the frequency and concentrations at which these pollutants are found in the effluent. Then, EPA compared sediment concentrations of pollutants at near-ZID and reference stations. Lastly, EPA compared the data with non-regulatory NOAA sediment quality guidelines developed for the National Status and Trends Program (NOAA, 1999). These NOAA guideline concentrations, listed in Table 14, represent the 10^{th} percentile (or Effects Range-Low) and 50^{th} percentile (or Effects Range-Median) of a toxicological effects database that has been compiled by NOAA for each parameter. The ERL is indicative of the concentrations below which adverse effects rarely occur and the ERM is representative of concentrations above which effects frequently occur.

Table 14. NOAA Sediment Quality Guidelines (ERL = Effects Range-Low; ERM = Effects Range-Median) and the applicant's 2008 sediment method detection limits (MDL).

Parameter	ERL	ERM	MDL (2008)[1]
Arsenic (µg/g)	8.2	70	0.025
Cadmium (µg/g)	1.2	9.6	0.025
Chromium (µg/g)	81	370	0.025
Copper (µg/g)	34	270	0.025
Lead (µg/g)	46.7	218	0.025
Mercury (µg/g)	0.15	0.71	0.01
Nickel (µg/g)	20.9	51.6	0.025
Silver (µg/g)	1	3.7	0.025
Zinc (µg/g)	150	410	0.025
Total DDTs (ng/g)	1.58	46.1	1
Total PCBs (ng/g)	22.7	180	1
Total PAHs (ng/g)	4,022	44,792	1

[1] *Applicant's MDLs found in section 10.4 of Goleta NPDES Monitoring and Reporting Program Annual Reports*

Table III.H.1.d in the application lists all known industrial sources for pollutants of concern found in the Goleta effluent. Goleta lists additional sources of pollutants in section II.C.1, which include treated municipal and industrial wastewater, stormwater runoff, disposal of dredged materials, aerial fallout, and oil and hazardous material spills.

Trace metals and complex organics in the Goleta effluent are either at low concentrations or below detection limits. For example, Goleta detected low concentrations of mercury in 33 of 51 monthly effluent samples, with a highest daily maximum of 0.25 µg/l.

In sediment, EPA found no significant differences between pollutant concentrations at near-ZID and reference stations. Pollutant concentrations at near-ZID stations B4 and B5 are similar, although station B5 tends to exhibit slightly higher concentrations than station B4. This difference may be due to the higher amount of fine sediments at station B5 than at station B4, as pollutants accumulate more in fine, rather than coarse, sediments. A summary of sediment pollutant concentrations during the last permit term is shown in Table 15.

Table 15. Summary of 2004 through 2008 sediment pollutant concentrations (µg/g unless otherwise specified) at offshore monitoring stations.

	B1	B2	B3	B4	B5	B6
TOC						
Minimum	4,500	4,900	3,600	2,200	3,300	2,200
Average	7,210	6,340	4,840	4,200	6,000	3,760
Maximum	9,100	8,900	6,600	6,400	10,500	4,500
TKN						
Minimum	450	410	310	310	310	210
Average	490	550	436	424	484	338
Maximum	530	690	520	530	600	490
AVS						
Minimum	0.05	1.96	0.36	1.13	0.78	0.05
Average	5.98	7.39	67.1	6.64	5.57	6.88
Maximum	24.5	10.7	303	12.7	11.9	27.0
Aluminum						
Minimum	5,548	6,298	4,669	4,567	5,598	5,121
Average	8,262	9,572	8,134	6,957	9,497	6,508
Maximum	15,900	18,690	16,840	12,900	22,100	10,600
Antimony						
Minimum	0.126	0.129	0.110	0.094	0.118	0.090
Average	0.155	0.195	0.138	0.130	0.197	0.122
Maximum	0.190	0.296	0.170	0.199	0.360	0.160
Arsenic						
Minimum	4.17	4.13	3.64	3.78	3.81	3.38
Average	4.64	5.16	4.51	4.38	4.79	4.39
Maximum	5.10	5.93	5.33	5.01	5.81	5.56
Cadmium						
Minimum	0.281	0.394	0.327	0.226	0.257	0.330
Average	0.377	0.483	0.432	0.352	0.390	0.400
Maximum	0.450	0.610	0.560	0.470	0.560	0.495
Chromium						
Minimum	18.7	22.8	17.4	15.5	18.7	17.4
Average	24.5	28.6	24.3	21.7	28.8	20.5

	B1	B2	B3	B4	B5	B6
Maximum	37.7	42.9	39.2	30.9	56.5	25.9
Hexavalent Chromium						
Minimum	0.05	0.05	0.05	0.05	0.05	0.05
Average	0.05	0.08	0.06	0.06	0.12	0.08
Maximum	0.05	0.10	0.06	0.06	0.19	0.10
Copper						
Minimum	4.94	5.39	4.33	4.51	4.85	2.66
Average	6.02	7.18	5.92	5.86	7.77	4.00
Maximum	8.69	9.99	8.96	7.81	12.90	4.69
Iron						
Minimum	8,813	10,230	8,260	7,289	8,640	6,835
Average	10,506	12,544	10,568	9,109	12,419	8,888
Maximum	15,200	18,100	16,000	12,300	22,500	10,100
Lead						
Minimum	3.13	4.35	2.92	3.62	4.07	2.98
Average	4.25	4.96	4.36	4.01	4.49	3.34
Maximum	5.28	6.19	5.54	4.68	5.50	3.69
Mercury						
Minimum	0.01	0.01	0.01	0.01	0.01	0.01
Average	2.67	3.26	3.40	3.22	3.50	7.73
Maximum	13.3	16.2	16.9	16.0	17.4	38.6
Nickel						
Minimum	14.1	15.4	13.0	10.9	12.0	8.69
Average	16.5	19.6	16.4	13.4	19.1	13.2
Maximum	22.2	25.4	23.2	16.8	34.2	15.6
Selenium						
Minimum	0.290	0.327	0.274	0.201	0.229	0.257
Average	0.587	0.663	0.526	0.519	0.566	0.523
Maximum	0.930	1.39	1.00	1.14	1.25	1.18
Silver						
Minimum	0.025	0.025	0.025	0.025	0.025	0.025
Average	0.073	0.094	0.072	0.074	0.079	0.119
Maximum	0.150	0.171	0.130	0.169	0.165	0.210
Tin						
Minimum	0.318	0.405	0.398	0.365	0.346	0.313
Average	0.545	0.645	0.566	0.605	0.606	0.454
Maximum	0.925	1.08	0.970	0.950	0.930	0.690
Zinc						
Minimum	21.7	24.0	19.7	19.1	20.6	15.3
Average	25.6	31.4	26.3	23.6	30.3	21.8
Maximum	34.0	41.5	36.8	29.9	46.2	25.8
Total DDT (ng/g)						
Minimum	0.00	0.00	0.00	0.00	0.00	0.00
Average	2.16	1.56	2.00	0.92	1.54	1.52

	B1	B2	B3	B4	B5	B6
Maximum	5.40	4.80	6.20	2.00	3.60	5.20
Total Chlordane (ng/g)						
Minimum	--[1]	--	--	--	--	--
Average	--	--	--	--	--	--
Maximum	--	--	--	--	--	--
Total PCB (ng/g)						
Minimum	--	--	--	--	--	--
Average	--	--	--	--	--	--
Maximum	--	--	--	--	--	--
Total PAH (ng/g)						
Minimum	103	0.00	37.4	22.8	42.0	19.4
Average	137	302	109	46.7	96.9	97.1
Maximum	179	944	180	70.1	148	193

[1] *Not detected*

Except for mercury, nickel, and total DDT, trace metals and complex organics are at concentrations below ERL thresholds. Figure 4 shows sediment concentrations of mercury are fairly low and consistent over offshore monitoring stations, except for significantly higher concentrations found in 2005. The mean mercury concentrations at near-ZID stations B4 and B5 were 3.22 and 3.50 µg/g, respectively, while the mean concentration at reference station B6 was 7.73 µg/g. These concentrations exceed both the ERL and the ERM, and reflect the unusually high levels of mercury in 2005. If we exclude the 2005 concentrations, the mean mercury concentration for survey years 2004, and 2006-2008 is 0.02 µg/g, and the maximum mercury concentration is 0.06 µg/g, which are both below the ERL threshold. It is unlikely Goleta's discharge caused the high sediment concentrations in 2005, as effluent concentrations during the sediment survey month were low: 0.02 µg/l (or ng/g) daily maximum and 0.05 µg/l (ng/g) 6-month median.

The 2005 mercury concentrations are much higher than the concentrations found during the other annual surveys and this trend is shown in many of the other pollutant profiles. Nickel concentrations in sediment also exhibit higher concentrations in 2005. Figure 5 shows 5 of 30 sediment samples contained nickel concentrations above the ERL, four of which occurred in 2005. The daily maximum and 6-month median effluent concentrations of nickel during the sediment survey month were low, both measuring at 6 µg/l (ng/g). Record levels of rainfall occurring within the Goleta area during 2005 resulted in significant stormwater runoff, which may be responsible for the higher concentrations of pollutants found in sediments during the 2005 survey.

Figure 6 shows 12 of 30 sediment samples contained total DDT concentrations above the ERL; however 15 of the 30 samples were below the detection limit, Goleta did not detect total DDT in any effluent samples, and sediment concentrations at near-ZID and reference stations were not significantly different. DDT and its derivatives were banned for use in the United States in 1972. Thus, contribution of total DDT from the outfall to sediments is minimal.

In summary, EPA found low effluent concentrations, which comply with COP objectives, no significant difference between near-ZID and reference station sediment concentrations, and concentrations in sediment mostly below the ERL. Thus, EPA concludes the outfall is not contributing to increased concentrations of trace metals and complex organics in ocean sediments and those concentrations are below levels which would degrade marine life.

2. Impact of the Discharge on Public Water Supplies

Under 40 CFR 125.62(b), the discharge must allow for the attainment or maintenance of water quality that assures protection of public water supplies. According to the applicant, there are no existing seawater supply intakes within 10 miles of the Goleta discharge. The City of Santa Barbara constructed a desalination facility in 1992 with an intake located 11 miles east of the Goleta outfall; however this facility was mothballed and sections of the facility were sold. Based on the ability of the Goleta discharge to meet water quality standards and the absence of desalination facilities in the vicinity of the discharge, EPA concludes the applicant's proposed modified discharge will have no effect on public water supplies.

3. Impact of the Discharge on Shellfish, Fish, and Wildlife

Under 40 CFR 125.62(c), the applicant's modified discharge must allow for the attainment or maintenance of water quality that assures protection and propagation of a balanced indigenous population of shellfish, fish, and wildlife. A balanced indigenous population must exist immediately beyond the zone of initial dilution and in all other areas beyond the zone of initial dilution where marine life is actually or potentially affected by the applicant's modified discharge. Conditions within the zone of initial dilution must not contribute to extreme adverse biological impacts, including, but not limited to, the destruction of distinctive habitats of limited distribution, the presence of disease epicenter, or the stimulation of phytoplankton blooms which have adverse effects beyond the zone of initial dilution. The term "balanced indigenous population", as defined in 40 CFR 125.58(f), means an ecological community that exhibits characteristics similar to those of nearby, healthy communities existing under comparable but unpolluted environmental conditions; or may reasonably be expected to become re-established in the polluted water body segment from adjacent waters if sources of pollution were removed. In addition to these requirements, Chapter II of the COP states "marine communities, including vertebrate, invertebrate, and plant species, shall not be degraded." EPA's review of the benthic, fish, and macroinvertebrate community structures is discussed in the following sections.

a. Benthic Community Structure

Under the existing permit, Goleta collects five replicate 0.1 m^2 sediment samples at offshore monitoring stations B1 through B6 on an annual basis in the month of October. From these samples, Goleta determines the abundance, number of species, diversity, richness, dominance, infaunal trophic index, and benthic response index. The 2004 through 2008 benthic community metric results are summarized in Table 16. EPA reviewed the data and performed two-way analyses of variance for each benthic

community metric to determine the effect of Goleta's discharge on the benthic community structure.

Table 16. Summary of 2004 through 2008 Benthic Community Metric Data.

	B1	B2	B3	B4	B5	B6
Number of Species						
Minimum	135	111	143	125	134	139
Average	165	144	155	137	149	157
Maximum	185	174	174	162	177	190
Abundance						
Minimum	582	677	1093	854	741	910
Average	1280	1182	1441	1141	1242	1121
Maximum	2164	1621	1775	1580	1804	1349
Diversity (Shannon)						
Minimum	3.5	3.1	3.4	3.1	3.5	3.4
Average	3.9	3.7	3.6	3.4	3.7	3.7
Maximum	4.2	4.2	3.9	3.7	3.9	4.1
Richness (Margalef)						
Minimum	21	16	20	18	19	20
Average	23	20	21	19	21	22
Maximum	25	23	23	22	23	26
Dominance (Swartz)						
Minimum	19	13	20	16	24	22
Average	32	26	25	21	29	29
Maximum	42	37	30	27	33	34
Infaunal Trophic Index (ITI)						
Minimum	73	72	73	68	72	74
Average	76	77	75	71	75	77
Maximum	80	81	77	72	77	80
Benthic Response Index (BRI)						
Minimum	25	25	23	25	25	24
Average	27	27	26	27	26	26
Maximum	31	28	29	30	27	28

Number of Species and Abundance

The combination of high benthic abundance (number of individuals) due to organic enrichment and a decrease in the number of benthic species near an outfall relative to a reference station would indicate an outfall-related effect. EPA found no significant difference in species abundance or number of species between near-ZID monitoring stations, B4 and B5, and reference station B6.

Species Richness

Goleta calculated Margalef Richness, which equals the number of species divided by the natural log of the abundance. EPA found levels of richness to be similar to those reported in the 1990s, and higher than those reported in the late 1990s.

Species Diversity and Dominance

Low species diversity and high dominance near an outfall relative to a reference station would indicate an outfall-related effect. Shannon Diversity takes into account the number and evenness of species and Swartz Dominance is the minimum number of species representing 75% of the total abundance in a given sample. EPA found significant differences between near-ZID monitoring station B4 and reference station B6 for both metrics. Diversity was higher at the reference station but dominance was also higher at the reference station. Since diversity and dominance are inversely related, and these results do not represent that relationship, these data are indeterminate.

Infaunal Trophic & Benthic Response Indices

Since the above metrics, especially abundance, can be affected by natural temporal variability, the infaunal trophic index (ITI) and the benthic response index (BRI) were developed to better assess benthic community health. Goleta reported both the ITI and the BRI for each monitoring station. EPA found levels of the ITI to be similar to those found in the 1990s. The BRI is a more recently developed index and unlike other indices, has low seasonal variability and is not related to grain size or latitude (Smith, R.W. et al., 2001). BRI thresholds to indicate loss in biodiversity were developed for the Southern California Bight (Smith, R.W. et al., 2001). A BRI at 25 or below indicates reference conditions. The threshold for loss in biodiversity is set at a BRI of 34 and the threshold for loss in community function is set at a BRI of 44. Between 2004 and 2008, BRI values at near-ZID stations, B4 and B5, and reference station B6 were between 24 and 30, ranging between reference conditions and response level 1. According to Smith, R.W. et al., 2001, sites with index values of 25 to 33 represent only minor deviation from reference conditions. A BRI of 33 is actually the maximum score for reference sites in the calibration and validation data sets used for development of the index. EPA also found no significant difference in BRI values between near-ZID stations, B4 and B5, and reference station B6.

As the benthic community metrics indicate no significant outfall effect, EPA finds the outfall is not degrading the benthic community.

b. Fish and Macroinvertebrate Community Structure

Under the existing permit, Goleta conducts duplicate trawls annually at station TB3 (near the outfall) and station TB6 (3,000 meters east of the outfall). From these trawls, Goleta determines the abundance, number of species, diversity, and dominance for both fish and macroinvertebrates. The 2004 through 2008 annual trawl results are summarized in Table 17. EPA reviewed this data to determine the effect of Goleta's discharge on the fish and macroinvertebrate community structure.

Table 17. Summary of Annual Fish and Macroinvertebrate Trawl Data.

	Fish		Macroinvertebrates	
Abundance	TB3	TB6	TB3	TB6
2004	20	118	2	4
2005	5	29	2	1
2006	32	80	5	29

	Fish		Macroinvertebrates	
Abundance	TB3	TB6	TB3	TB6
2007	129	159	4	5
2008	11	7	4	2
Number of Species				
2004	7	13	2	3
2005	3	7	2	1
2006	5	10	2	2
2007	12	9	3	4
2008	4	3	2	1
Diversity				
2004	1.5	1.5	0.6	0.8
2005	1.0	1.3	0.6	0.0
2006	1.0	1.4	0.5	0.4
2007	1.0	1.1	0.8	1.1
2008	1.0	1.0	0.6	0.0
Dominance				
2004	3	3	2	3
2005	3	3	2	1
2006	2	3	2	2
2007	2	2	2	3
2008	2	2	2	1

EPA performed two-way analyses of variance for each community metric and determined there were no significant differences between near-ZID station TB3 and reference station TB6 in abundance, number of species, diversity, or dominance in the fish and macroinvertebrate communities. Thus, EPA concludes the outfall is not degrading the fish and macroinvertebrate community structures.

4. Impact of the Discharge on Recreational Activities

Under 40 CFR 125.62(d), the applicant's modified discharge must allow for the attainment or maintenance of water quality that allows for recreational activities beyond the zone of initial dilution, including, without limitation, swimming, diving, boating, fishing, and picnicking, and sports activities along shorelines and beaches. According to the applicant, there are no restrictions on recreational activities in the vicinity of the discharge, except for an emergency safety zone for commercial shellfish harvesting within a one-mile radius of the discharge point. The following assessment to determine whether the discharge will protect recreational activities consists of EPA's review of both the applicant's bioaccumulation and fish consumption data, and for water contact recreation, the applicant's effluent and water column bacteria data.

a. Bioaccumulation and Fish Consumption

Bioaccumulation is a process by which chemical contaminants undergo uptake and retention in organisms via various pathways of exposure. For example, fishes can accumulate contaminants through adsorption and absorption of dissolved chemicals in the

water or through ingestion or assimilation of contaminants in food. Once a contaminant is incorporated into the tissues of an organism, it may resist metabolic excretion and accumulate. Higher trophic level organisms may then feed on contaminated prey and further concentrate the contaminant in their tissues. This process can lead to concentrations of contaminants in fish tissue that are of ecological and human health concern.

Chapter II of the COP requires, "the natural taste, odor, and color of fish, shellfish, or other marine resources used for human consumption shall not be altered" and "the concentrations of organic materials in fish, shellfish, or other marine resources used for human consumption shall not bioaccumulate to levels that are harmful to human health."

Annually, Goleta collects speckled sanddab from duplicate trawls at stations TB3 (near the outfall) and TB6 (3,000 meters east of the outfall). From these trawls, Goleta analyzes three replicate samples for each toxic parameter specified in the existing permit. Goleta selected the speckled sanddab for fish muscle and liver bioaccumulation analyses, as it is the most abundant fish species found consistently during the trawls. To determine bioaccumulation in shellfish, Goleta deploys mussel (whole bivalve) arrays at stations B3, B4, and B6, (located 250, 25, and 3,000 meters, respectively, from the outfall), and collects laboratory control mussels at Anacapa Island.

EPA examined concentrations of toxics in fish liver, fish muscle, and whole bivalve tissue sampled annually in October from 2004 to 2008 to evaluate bioaccumulation in the area of the Goleta outfall. The following discussion involves the evaluation of both the spatial and temporal trends and the comparison of concentrations to EPA screening values and California fish contaminant goals. The 15 toxics are discussed by tissue type.

Fish Liver

EPA reviewed concentrations of arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, zinc, total DDTs, total chlordane, total PCBs, arochlors of PCBs, and total PAHs in speckled sanddab liver tissue. The metal with the highest concentration in liver tissue at station TB3 is zinc, with a mean concentration of 53.43 mg/kg dry weight (dw). The complex organic with the highest concentration in liver tissue is total DDT, with a mean concentration of 866.54 µg/kg dw. These concentrations are similar to concentrations Goleta reported during the late 1990s.

EPA looked for spatial and temporal trends in pollutant concentrations that would indicate bioaccumulation. Except for total PCBs, EPA did not observe any spatial or temporal trends in liver tissue pollutant concentrations. Figure 7 summarizes the average concentration of total PCBs in liver tissue from 2004 through 2008. Concentrations at TB3 and TB6 fluctuate and increase together over time. For the five-year period, the overall mean concentrations of total PCBs are 70.57 µg/kg dw at nearfield station TB3 and 68.32 µg/kg dw at reference station TB6. Although increasing over the permit term, these total PCB concentrations in liver tissue are similar to those Goleta reported during the late 1990s. There are no screening values for total PCBs in liver tissue; however, as discussed below, concentrations in muscle tissue meet EPA screening values for recreational fishing. PCBs were banned for industrial use in the United States in 1977.

Goleta did not detect concentrations of total PCBs in any effluent samples. Thus, it is unlikely the outfall is causing PCB bioaccumulation in liver tissue.

Fish Muscle

EPA reviewed concentrations of arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, zinc, total DDTs, total chlordane, total PCBs, arochlors of PCBs, and total PAHs in speckled sanddab muscle tissue. In the following discussion, EPA looks at the spatial and temporal trends of each parameter and compares the concentrations to EPA screening values and California fish contaminant goals.

U.S. EPA has developed recommended target analyte screening values for recreational fishers. These screening values (SVs) are summarized in Table 18 and are defined as "concentrations of target analytes in fish or shellfish tissue that are of potential public health concern and that are used as threshold values against which levels of contamination in similar tissue collected from the ambient environment can be compared. Exceedance of these SVs should be taken as an indication that more intensive site-specific monitoring and/or evaluation of human health risk should be conducted" (USEPA, 2000).

Table 18. Selected U.S. EPA recommended target analyte screening values for recreational fishers. Based on fish consumption rate of 17.5 grams per day, 70 kilograms body weight (all adults), and, for carcinogens, 10^{-5} risk level, and 70-year lifetime.

Target Analyte	Screening Values (mg/kg wet weight)	
	Noncarcinogens	Carcinogens
Arsenic (inorganic)	1.2	0.026
Cadmium	4.0	--
Mercury (methylmercury)	0.3*	--
Selenium	20	--
Total Chlordane (sum of cis- and trans-chlordane, cis- and trans-nonachlor, and oxychlordane)	2.0	0.114
Total DDT (sum of 4,4'- and 2,4'-isomers of DDT, DDE, and DDD)	2.0	0.117
Total PCBs (sum of cogeners or arochlors)	0.08	0.02
Total PAHs	--	5.47E-03

*From EPA's tissue-based 304(a)(1) water quality criterion for human health (USEPA, 2001)

The California Office of Environmental Health Hazard Assessment (OEHHA) has developed fish contaminant goals for chlordane, DDTs, dieldrin, methylmercury, PCBs, selenium, and toxaphene. These fish contaminant goals (FCGs), listed in Table 19, are estimates of contaminant levels in fish that pose no significant health risk to individuals consuming sport fish at a standard consumption rate of eight ounces per week (32 grams per day) (Klasing and Brodberg, 2008).

Table 19. Fish Contaminant Goals for selected fish contaminants based on cancer and non-cancer risk using an eight ounce per week (prior to cooking) consumption rate (32 grams per day).

Contaminant	Fish Contaminant Goal (µg/kg, wet weight)
Chlordane $(mg/kg/day)^{-1}$	5.6
DDTs $(mg/kg/day)^{-1}$	21
Methylmercury (mg/kg-day)	220
PCBs $(mg/kg/day)^{-1}$	3.6
Selenium (mg/kg-day)	7,400

The metals with the highest concentrations in muscle tissue at station TB3 are zinc and arsenic, with mean concentrations of 11.85 mg/kg dw and 7.04 mg/kg dw, respectively. The complex organic with the highest concentration in muscle tissue is total PAHs, with a mean concentration of 13.13 µg/kg dw.

Except for arsenic and total PAHs, pollutant concentrations in muscle tissue meet EPA screening values. All pollutant concentrations meet the OEHHA fish contaminant goals.

Arsenic. Figure 8 summarizes the average dry weight concentration of arsenic in muscle tissue during October, from 2004 through 2008. Concentrations at TB3 and TB6 are similar, increasing from 2004 to 2005 and then leveling out through 2008. For the five-year period, the overall mean concentrations (dry weight) of arsenic are 7.04 mg/kg at nearfield station TB3 and 6.06 mg/kg at reference station TB6. Corresponding wet weight (ww) concentrations of arsenic in muscle tissue range from 0.104 to 2.07 mg/kg at TB3 and 0.224 to 1.72 mg/kg at TB6. These concentrations exceed the EPA screening values of 1.2 and 0.026 mg/kg ww. There is no OEHHA fish contaminant goal for arsenic. Although these concentrations exceed screening values, arsenic concentrations in fish and other species have been found at concentrations between 0.1 to over 50 mg/kg ww in the Southern California Bight (Mearns et al., 1991). Goleta detected arsenic in only 2 of 51 monthly effluent samples and these two samples were at low concentrations (0.005 mg/l). Reference station concentrations also exceeded screening values. Thus, it is unlikely the outfall is causing bioaccumulation of arsenic in muscle tissue.

Total PAHs. Figure 9 summarizes the average dry weight concentration of total PAHs in muscle tissue during October, from 2004 through 2008. Goleta did not detect total PAHs until 2007. Concentrations at TB3 and TB6 are similar, increasing from 2007 to 2008. For the survey period, the overall mean concentrations (dry weight) of total PAHs are 13.13 µg/kg at nearfield station TB3 and 13.27 µg/kg at reference station TB6. Corresponding wet weight concentrations of total PAHs in muscle tissue range from 2.45 to 5.20 µg/kg at TB3 and 4.42 to 5.65 µg/kg at TB6. Concentrations of total PAHs at TB3 are below the EPA screening level of 5.47 µg/kg; however, the 2008 TB6 concentration of total PAHs is above the screening level. There is no OEHHA fish contaminant goal for total PAHs. As concentrations of total PAHs only exceeded screening values at reference station TB6 and Goleta did not detect concentrations of total PAHs in any effluent samples, it is unlikely the outfall is causing bioaccumulation of total PAHs in fish muscle.

EPA observed a temporal trend over the permit term of zinc concentrations in muscle tissue. Figure 10 summarizes the average dry weight concentration of zinc in muscle tissue during October, from 2004 through 2008. Concentrations at TB3 and TB6 increase together over time. For the survey period, the overall mean concentrations (dry weight) of zinc are 11.85 mg/kg at nearfield station TB3 and 13.63 mg/kg at reference station TB6. There is no EPA screening value or OEHHA fish contaminant goal for zinc. Effluent concentrations of zinc also appear to be slightly increasing over time, but consistently meet water quality standards. Additionally, reference station concentrations are increasing and are higher than nearfield station concentrations. Thus, it is unlikely the outfall is causing bioaccumulation of zinc in muscle tissue.

Whole Bivalves

EPA reviewed concentrations of arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, zinc, total DDTs, total chlordane, total PCBs, arochlors of PCBs, and total PAHs in whole bivalve tissue. As with fish tissue, the metal with the highest concentrations in bivalve tissue at near-ZID station B4 is zinc, with a mean concentration of 118.46 mg/kg dw. Zinc concentrations at station B4 are similar to those found at the control station. The complex organic with the highest concentration in bivalve tissue is total DDT, with a mean concentration of 51.13 µg/kg dw at near-ZID station B4. Concentrations of total DDT at the control station were actually higher than those found at station B4.

Except for total PAHs, EPA did not observe any spatial or temporal trends in pollutant concentrations in bivalve tissue. Figure 11 summarizes the average concentration of total PAHs in bivalve tissue during October, from 2004 through 2008. Concentrations at stations B3, B4, B6, and Control (Anacapa Island) increase over time since 2006, with the highest concentrations found at the control station. For the survey period, the overall mean concentrations of total PAHs are 19.69, 17.35, 10.54, and 62.22 µg/kg dw at station B3, near-ZID station B4, station B6, and the control station, respectively. Goleta did not detect concentrations of total PAHs in any effluent samples. Bivalve tissue concentrations at the control station exceed concentrations at near-ZID station B4 and are also increasing over time. Thus, it is unlikely the outfall is causing total PAH bioaccumulation in bivalve tissue.

It should be noted that bivalve tissue concentrations of all complex organics (total DDTs, total chlordane, total PCBs, arochlors of PCBs, and total PAHs) are higher at the control station than at the nearfield stations and concentrations of total chlordane, total PCBs, and total arochlors of PCBs were only detected in 2008. The applicant explained the latter to be due to a change in the laboratory method, involving a larger sample size before extraction.

Conclusion on Bioaccumulation

Based on this review of fish liver, muscle and whole bivalve tissues, EPA finds the modified discharge will comply with COP water quality objectives for biological characteristics of ocean waters. EPA also concludes the modified discharge will allow for the attainment or maintenance of water quality which allows for recreational activities (fishing) beyond the zone of initial dilution.

b. Water Contact Recreation

As stated above, under 40 CFR 125.62(d), the applicant's modified discharge must allow for the attainment or maintenance of water quality which allows for recreational activities beyond the zone of initial dilution, including, without limitation, swimming, diving, boating, fishing, and picnicking, and sports activities along shorelines and beaches. This section describes EPA's review of effluent and water column bacteria monitoring data provided by the applicant, to determine the impact of the discharge on recreational activities.

According to the applicant, recreational activities within a 5-mile radius of the Goleta outfall include sunbathing, snorkeling, scuba diving, surfing, picnicking, swimming, wading, boating, fishing, kayaking, and jet skiing. Much of this recreation takes place at the heavily used Goleta Beach County Park. In addition, occasional boat launching and fishing occur at the Goleta Pier, located just east of the outfall.

The State Water Resources Control Board established water-contact standards for total coliform, fecal coliform, and enterococcus in Chapter II of the COP. These standards are applied in State waters throughout the water column "within a zone bounded by the shoreline and a distance of 1,000 feet from the shoreline or the 30-foot depth contour, whichever is further from the shoreline, and in areas outside this zone used for water contact sports, as determined by the Regional Board (i.e., waters designated as REC-1), but including all kelp beds." Table 20 provides a summary of the water-contact standards from the COP.

Table 20. California Ocean Plan Water-Contact Standards.

Indicator	30-day Geometric Mean (per 100 ml)	Single Sample Maximum (per 100 ml)
Total Coliform	1,000	10,000
Fecal Coliform	200	400
Total coliform when fecal coliform:total coliform ratio > 0.1	--	1,000
Enterococcus	35	104

Goleta disinfects by chlorination and dechlorinates the effluent prior to discharge. The existing NPDES permit requires Goleta to maintain a total chlorine residual of 5 mg/l at the end of the chlorine contact channel. According to data provided in the application, this limit was consistently met over the permit term. The permit also requires Goleta to disinfect the effluent such that no more than 10% of the final effluent samples in any monthly period shall exceed a total coliform density of 2,400 MPN/100ml, and no single sample shall exceed 16,000 MPN/100ml. The permit does not provide effluent limits for fecal coliform or enterococcus; however, monitoring is still required.

Goleta conducts the required monitoring for total coliform, fecal coliform, and enterococcus concentrations in the effluent, offshore water column, and surf zone water column. Samples are taken five days per week from the effluent, quarterly from the offshore stations, and weekly from the surf zone stations. Depending on the season and the potential for rain events to increase the concentration of bacteria, Goleta changes the

number of laboratory dilutions in the analyses to detect and quantify higher concentrations of bacteria. Sometimes the maximum detection is "≥16,000 MPN/100ml", and sometimes it is "≥1,600 MPN/100ml". The method detection limit is "< 2 MPN/100ml." The following sections describe EPA's review of effluent, offshore, and surf zone monitoring data.

Effluent

EPA reviewed monthly average and highest monthly single sample maximum effluent data from 2005 through 2009 for total coliform, fecal coliform and enterococcus. One exceedance of the total coliform single sample maximum permit limit (>16,000 MPN/100ml) occurred in February 2008. A break in a chlorine pipe caused the exceedance. Goleta promptly restored the pipe. For this month, Goleta also recorded high single sample maximums of fecal coliform (>16,000 MPN/100ml) and enterococcus (>1,600 MPN/100ml). On average, bacteria concentrations in the effluent were low. For the five-year period, the average total coliform concentration was 60 MPN/100ml, the average fecal coliform concentration was 20 MPN/100ml, and the average enterococcus concentration was 5 MPN/100ml.

Offshore, Plume, and Nearshore

Goleta performs quarterly (January/April/July/October) water column sampling at offshore (B1-B6), plume (WC-ZID and WC-100M), and nearshore (K1-K5) stations. Station WC-ZID is located 25 meters from the outfall in the direction of the wastewater plume and Station WC-100M is located 100 meters from the outfall in the same heading as station WC-ZID. Offshore stations are located between 1,500 meters west of the outfall to 3,000 meters east of the outfall. Nearshore stations are located inshore of the outfall terminus and between 1,200 meters west and east of the outfall at the edge of the kelp bed. Goleta samples at three depths: the surface, middle, and bottom. The middle sampling depths are 12 meters at offshore stations, 16 meters at plume stations, and 9 meters at nearshore stations.

EPA reviewed 2004 through 2008 water column data in comparison to single sample maximum and fecal to total coliform ratio criteria only, because sample frequency did not allow for comparison to 30-day geometric mean criteria. EPA observed one exceedance (measured at 16,000 MPN/100ml) of the single sample maximum criteria for total coliform. The exceedance occurred at the surface of station B6 in the winter (January) of 2004, ten months before the start of the last permit term. Of the 780 samples taken over the five-year period, only 21% were above the method detection limit (2 MPN/100ml). Of these, excluding the one exceedance, only three samples were above 1,000 MPN/100ml: 1,600 MPN/100ml at the surface of station WC-ZID in the winter (January) of 2005, 2,200 MPN/100ml at the bottom of station B5 in the summer (July) of 2005, and 1,700 MPN/100ml at the surface of station B4 in the spring (April) of 2006. The latter measurement exceeded the single sample maximum criteria for total coliform of 1,000 MPN/100ml when the ratio criteria of fecal to total coliform exceeds 0.1. In this case, the ratio of fecal to total coliform was 0.6. EPA found none of the total coliform exceedances at offshore stations to coincide in time with the exceedance in Goleta's effluent.

EPA found one fecal coliform exceedance (measuring at 1,400 MPN/100ml) at offshore, plume, and nearshore stations at the bottom of station B5 in the summer (July) of 2005. The same sample caused the ratio exceedance for total coliform. Of the 780 samples, only 9% (71) were above the detection limit. The maximum plume and nearshore measurements of fecal coliform were 17 MPN/100ml (at station WC-100M) and 30 MPN/100ml (at station K2), respectively. Both of these measurements were found at the surface in the spring (April) of 2006. In comparison, fecal coliform concentrations in Goleta's effluent during July 2005 and April 2006 were low, measuring at 17 and 7 MPN/100ml, respectively.

EPA found no exceedances of the COP criteria for enterococcus in the offshore, plume, and nearshore monitoring data. Only 7% (56) of the 780 samples were above the detection limit. The maximum offshore measurement of enterococcus was 50 MPN/100ml, from the bottom of station B3 in the winter (January) of 2005. The maximum plume measurement was 23 MPN/100ml, from the bottom of station WC-ZID in the spring (April) of 2005, and the maximum nearshore measurement was 80 MPN/100ml, from the middle depth of station K5 in the spring (April) of 2006.

In 2008, no exceedances of total coliform, fecal coliform, or enterococcus occurred at offshore, plume, and nearshore stations. In fact, EPA found no measurements above the detection limit for fecal coliform and enterococcus. For total coliform, only 4% (7 of 156) of the samples measured above the detection limit, with the highest measurement of 50 MPN/100ml occurring in the spring (April) at station B5.

Surf Zone

Goleta also conducts weekly monitoring at surf zone (A, A1, A2, B, C, D, E and Goleta Slough) stations. Surf zone stations are located at the shoreline from Goleta Point to beyond Goleta Slough at 1,000 meters east of the outfall line. EPA reviewed weekly monitoring data from 2004 through 2008 of total coliform, fecal coliform, and enterococcus at the eight surf zone stations. EPA found very few exceedances of water quality standards. Only 1.2%, 2.6%, and 4.8% of samples exceeded the single sample maximum criteria for total coliform, fecal coliform, and enterococcus, respectively. About half of these exceedances occurred at the Goleta Slough monitoring station.

From the applicant's weekly data, EPA calculated 30-day geometric means for January 2004 through December 2008. Samples at the maximum detection limits of "≥1,600 MPN/100ml" and "≥16,000 MPN/100ml" were considered equal to values of 1,600 and 16,000 MPN/100ml and samples at the method detection limit of "< 2" were considered equal to a value of 2 MPN/100ml. Only 11 total coliform, 7 fecal coliform, and 16 enterococcus samples exceeded the 30-day geometric mean criteria, equating to 2.3%, 1.5%, and 3.3% of the samples for each parameter, respectively. More than half of these exceedances occurred at the Goleta Slough station. The majority occurred between January and March 2005, but two of the total coliform exceedances at the Goleta Slough station occurred in January and February 2008. Each of these months correlate with high monthly flow measurements found upstream of Goleta Slough (USGS, 2009) and as mentioned above, NOAA recorded historically heavy rainfall in Santa Barbara County in January 2005 (NOAA, 2009). EPA finds the exceedances at the Goleta Slough surf zone

station are likely due to run-off from storm events and not caused by the discharge of effluent from Goleta's outfall.

Based on this review of effluent and water column data from offshore, plume, nearshore, and surf zone areas, EPA finds bacterial concentrations associated with the discharge of wastewater from the Goleta outfall are not likely to affect recreational uses in the Goleta area.

D. Establishment of a Monitoring Program

40 CFR 125.63 implements section 301(h)(3) of the CWA and requires the applicant to have a monitoring program designed to evaluate the impact of the modified discharge on the marine biota; demonstrate compliance with applicable water quality standards or criteria, as applicable; measure toxic substances in the discharge; and have the capability to implement these programs upon issuance of the 301(h)-modified permit. The frequency and extent of the monitoring program are determined by consideration of the applicant's rate of discharge, quantities of toxic pollutants discharged, and potentially significant impacts on receiving water, marine biota, and designated water uses.

The applicant has a well-established monitoring program, described in section III.F of the application, and has consistently implemented the program. The applicant proposes to keep the existing ambient monitoring program intact, but requests decreased sampling at the surf zone stations. Currently, the applicant samples surf zone stations weekly for total coliform, fecal coliform, and enterococcus. The applicant proposes sampling at the surf zone stations be initiated by a trigger based on the concentration of coliform in the effluent. The applicant requested this change in monitoring frequency during the last permit issuance, but EPA and the Regional Board denied the request.

EPA finds the applicant's existing monitoring program meets the requirements under 40 CFR 125.63 and the applicant has the resources to implement the program. EPA has considered the request for a change in surf zone monitoring frequency, but finds the current monitoring locations and frequency provide the data necessary to determine exceedances of water quality standards at surf zone stations are not associated with the discharge from the Goleta outfall. To maintain a 301(h) waiver, the applicant must meet the requirements of section 301(h)(2) and (3), which Goleta meets by monitoring at the 30-meter contour, the edges of the kelp bed, within the discharge plume, and along the surf zone. Together, data from these stations assists in the detection and measurement of any impacts due to system breaks, spills or ineffective chlorination/dechlorination. EPA also finds necessary the current sampling frequency for ensuring the protection of recreational use, such as that found at the heavily used Goleta Beach County Park.

E. Impact of Modified Discharge on Other Point and Non-point Sources

40 CFR 125.64 implements section 301(h)(4) of the CWA and requires the applicant's proposed modified discharge not result in the imposition of additional treatment requirements on any other point or non-point source. The applicant states no other discharges occur within the same open coastal waters as the Goleta discharge. The only known source of wastewater discharge in the vicinity of the Goleta outfall is the El Estero wastewater treatment plant, located 10 miles to the east, which provides full secondary

treatment and disinfection for its wastewater. For previous applications, the Regional Board determined the Goleta discharge will not affect any other point or non-point source discharges. For the 2009 application, the applicant submitted a letter on May 22, 2009 to the Regional Board requesting the required concurrence under 40 CFR 125.64(b). The granting of the 301(h) variance by EPA's Regional Administrator is contingent upon a determination by the Regional Board that the proposed discharge will not result in any additional treatment requirements on any other point or non-point sources.

F. Urban Area Pretreatment Program

Under 40 CFR 125.65, an applicant serving a population of 50,000 or more that has one or more toxic pollutants introduced into the POTW by one or more industrial dischargers must meet urban area pretreatment requirements. 40 CFR 125.65(b)(1) requires the applicant to demonstrate industrial sources introducing waste into the treatment works are either in compliance with all applicable pretreatment requirements, as described in 40 CFR 125.65(c) and including numerical standards set by local limits, or the applicant has in effect a program that achieves secondary equivalency, as described in 40 CFR 125.65(d). The applicant must also demonstrate that it will enforce these requirements, as required by 40 CFR 125.65(b)(2). As a large discharger, Goleta is subject to these requirements.

Goleta meets the urban area pretreatment requirement under 40 CFR 125.65(b)(1) through establishment of local discharge limits to control toxic pollutants which might be introduced by an industrial source. In implementing these limits, Goleta meets the Applicable Pretreatment Requirement under 125.65(c). As shown in Tables IIIH-2 and IIIH-3 of the application, Goleta imposes local limits for 44 pollutants and federal categorical limits for the metal finishing and electrical and electronic component categories.

Goleta has seven significant industrial users (SIUs). According to annual and quarterly pretreatment reports, three SIUs had violations of applicable pretreatment requirements during years 2005 through 2008. Two SIUs exceeded a local or federal limit once and compliance was met following issuance of Goleta's Notice of Violation (NOV) and subsequent resampling. The third SIU was in noncompliance three times for copper exceedances, twice for nickel exceedances and once for methylene chloride. The two nickel exceedances occurred within the same year, but the criteria for Significant Noncompliance under 40 CFR 403.8(f)(2)(viii) were not met. Goleta issued NOVs for each exceedance and required resampling. In 2006, the SIU was inspected by an EPA Contractor. EPA concludes Goleta has appropriately used enforcement tools to ensure pretreatment requirements are met and therefore, Goleta meets the requirements of 40 CFR 125.65(b)(2).

G. Toxics Control Program

In accordance with 40 CFR 125.66, the applicant must design a toxics control program to identify and ensure control of toxic pollutants and pesticides discharged in the effluent. Section 301(h) of the CWA requires both industrial and nonindustrial source control programs.

1. Chemical Analysis

40 CFR 125.66(a) requires the applicant to submit a chemical analysis of the current discharge for all toxic pollutants and pesticides defined in 40 CFR 125.58(aa) and (p). The analysis must be performed on two 24-hour composite samples (one dry-weather and one wet-weather). As a result of the established monitoring requirements specified in the existing permit, Goleta monitored certain parameters only in wet-weather months. Goleta conducts regular influent and effluent monitoring following sampling schedules specified in the existing permit. All metals, except for selenium are monitored monthly. Selenium and the remaining toxics, as listed in Table B of the California Ocean Plan, are monitored annually. Both influent and effluent monitoring data are reported in monthly, quarterly, and annual reports to the Regional Board and EPA. Goleta provided effluent data from 2004 through 2008 in electronic format as part of the application.

2. Toxic Pollutant Source Identification

Under 40 CFR 125.66(b), the applicant must submit an analysis of the sources of toxic pollutants identified in section 125.66(a) and to the extent practicable categorize the sources according to industrial and nonindustrial types. The applicant identifies and categorizes the industrial type facilities in the Goleta service area as part of the existing industrial pretreatment program. Table III.H.1 of the application lists the 43 industrial users by classification. Seven companies are listed as Class IV – Significant Industrial Users, and six of these are subject to categorical pretreatment requirements. The nonindustrial source control program is discussed below. Based on this information, EPA concludes the applicant meets the requirements at 40 CFR 125.66(b).

3. Industrial Pretreatment Requirements

Under 40 CFR 125.66(c), applicants with known or suspected industrial sources of toxic pollutants must have an approved industrial pretreatment program in accordance with 40 CFR 403. Goleta's industrial users generate 4 percent of the current flow. EPA approved the applicant's industrial pretreatment program on July 19, 1983. Goleta surveys the service area to determine if any businesses require an industrial wastewater discharge permit, regularly inspects its industrial users based on classification, and reports quarterly status and annual pretreatment reports to EPA and the Regional Board. Goleta also follows up on pretreatment compliance inspections conducted by the Regional Board. Based on this information, EPA concludes the applicant meets the requirements of 40 CFR 125.66(c).

H. Nonindustrial Source Control Program

40 CFR 125.66(d) implements section 301(h)(7) of the CWA and requires the applicant to have a proposed public education program designed to minimize the entrance of nonindustrial toxic pollutants and pesticides into the POTW and develop and implement additional nonindustrial source control programs, at the earliest possible schedule. These programs and schedules are subject to revision by the Regional Administrator during permit review and reissuance and throughout the term of the permit.

Goleta developed and implemented a nonindustrial toxics control program in 1986, which includes semi-annual sampling of wastewater collected from eight manholes, five of

which are in the residential sections of the service area. Samples are monitored for BOD, TSS, ammonia, oil and grease, pH, chlorides, total dissolved solids, trace metals, cyanide, and total toxic organics. Goleta publishes a semi-annual newsletter and holds workshops with local businesses to increase public awareness of plant operations, the sewer collection system, the biosolids program, pretreatment regulations and encourage pollution prevention. Based on this information, EPA concludes the applicant meets the requirements of 40 CFR 125.66(d).

I. Increase in Effluent Volume or Amount of Pollutants Discharged

40 CFR 125.67, which implements section 301(h)(8) of the CWA, states no modified discharge may result in any new or substantially increased discharges of the pollutant to which the modification applies above the discharge specified in the 301(h)-modified permit. The applicant must provide projections of effluent volume and mass loadings for any pollutants to which the modification applies, in five year increments, for the design life of the facility.

Table 21 shows the projections in mass loadings of total suspended solids and biochemical oxygen demand for which the permit modification is requested. The table compares these projections to the proposed modified permit limits.

Table 21. Projected Monthly Average Mass Loadings and Concentrations of Total Suspended Solids and Biochemical Oxygen Demand from the Goleta discharge.

Parameter	Units	2004-2008	2013	2018	Existing and Proposed Permit Limits
TSS	lbs/day	1,035	1,129	707	4,010
	mg/l	34	42	30	63
BOD	lbs/day	1,557	1,694	707	6,240
	mg/l	51	63	30	98

The projected mass loadings and concentrations of total suspended solids and biochemical oxygen demand in the Goleta effluent fall within the existing and proposed 301(h) modified permit limits. Goleta is subject to the terms of a settlement agreement, signed on November 10, 2004 with the Regional Board, requiring the conversion to full secondary treatment by 2014. This explains the projected decrease in mass loadings and concentrations for 2018. The existing permit limits the discharge flow to 7.64 MGD, restricting the effluent volume. Based on this information, EPA concludes the applicant meets the requirements of 40 CFR 125.67.

J. Compliance with Other Applicable Laws

Under 40 CFR 125.59(b)(3), a 301(h)-modified permit shall not be issued where such issuance would conflict with applicable provisions of State, local, or other federal laws or Executive Orders.

1. Coastal Zone Management

40 CFR 125.59(b)(3) requires issuance of a 301(h) modified NPDES permit comply with the Coastal Zone Management Act, 16 U.S.C. 1451 *et seq*. A 301(h) modified NPDES permit may not be issued unless the proposed discharge is certified by the State to comply with the applicable State coastal zone management program(s) approved under the Coastal Zone Management Act, or the State waives such certification.

The applicant notified the California Coastal Commission of its intent to renew the waiver in a letter dated May 22, 2009 and requested a determination of concurrence. The California Coastal Commission concurred on the last waiver in January 2005 and Goleta does not propose any changes in plant operation. The issuance of a 301(h) modified permit for the Goleta discharge is contingent upon California Coastal Commission certification.

2. Marine Sanctuaries

40 CFR 125.59(b)(3) requires issuance of a 301(h) modified NPDES permit comply with Title III of the Marine Protection, Research, and Sanctuaries Act, 16 U.S.C. 1431 *et seq*. A 301(h) modified permit may not be issued for a discharge located in a marine sanctuary designated pursuant to Title III if the regulations applicable to the sanctuary prohibit issuance of such a permit.

There are no federal marine sanctuaries in the vicinity of the Goleta outfall. The closest federal marine sanctuary is the Channel Islands Marine Sanctuary, which is well outside the influence of the outfall.

3. Endangered or Threatened Species

40 CFR 125.59(b)(3) requires issuance of a 301(h) modified NPDES permit comply with the Endangered Species Act, 16 U.S.C. 1531 *et seq*. A 301(h) modified NPDES permit may not be issued if the proposed discharge will adversely impact threatened or endangered species or critical habitats listed pursuant to the Endangered Species Act.

The applicant notified the United States Fish and Wildlife Service (USFWS) and the NOAA National Marine Fisheries Service (NMFS) of its intent to renew the waiver in a letter dated May 22, 2009 and requested a determination of concurrence with the Endangered Species Act. USFWS provided a list of endangered and threatened species which may occur in the vicinity of the discharge to EPA. EPA prepared a biological evaluation for the purposes of consultation under Section 7 of the Endangered Species Act and determined the continued discharge will have "no effect" on the California least tern, western snowy plover, southern sea otter, and tidewater goby. The brown pelican was on the list provided by USFWS; however, it was delisted on November 11, 2009. EPA's biological evaluation will be provided to USFWS for concurrence. EPA will also coordinate with NMFS regarding any listed marine species. The issuance of a 301(h)-modified permit for the Goleta discharge is contingent upon concurrence by the Services.

4. Fishery Conservation and Management

A 301(h)-modified permit shall not be issued where such issuance would conflict with the federal Magnuson-Stevens Fishery Conservation and Management Act, as amended (the MSA), 16 U.S.C. 1801 *et seq*.

The applicant notified the National Marine Fisheries Service of its intent to renew the waiver in a letter dated October 23, 2009 and requested concurrence that the modified discharge is consistent with the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act. The issuance of a 301(h)-modified permit for the Goleta discharge is contingent upon the National Marine Fisheries Service's concurrence.

K. State Determination and Concurrence

In accordance with 40 CFR 125.59(i)(2), no 301(h)-modified permit shall be issued until the appropriate State certification/concurrence is granted or waived, or if the State denies certification/concurrence, pursuant to 40 CFR 124.54.

In May 1984, EPA and the State of California signed a Memorandum of Understanding to jointly administer discharges that are granted 301(h) modifications from federal secondary treatment standards. Under California's Porter-Cologne Water Quality Control Act, the Regional Boards issue waste discharge requirements which serve as NPDES permits. The joint issuance of a 301(h)-modified NPDES permit for the Goleta discharge, which incorporates both the federal 301(h) variance and State waste discharge requirements will serve as the State's concurrence, pursuant to 40 CFR 124.54.

REFERENCES

Klasing, S. and R. Brodberg. 2008. Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene. Office of Environmental Health Hazard Assessment, Sacramento, CA. http://www.oehha.ca.gov/fish/gtlsv/pdf/FCGsATLs27June2008.pdf

Maughan, J.T. and C.A. Oviatt. 1993. Sediment and benthic response to wastewater solids in a marine mesocosm. Water Environment Research 65(7):879-889.

Mearns, A.J., M. Matta, G. Shigenaka, D. MacDonald, M. Buchman, H. Harris, J. Golas, and G. Lauenstein. 1991. Contaminant Trends in the Southern California Bight: Inventory and Assessment. NOAA Technical Memorandum NOS ORCA 62. National Oceanic and Atmospheric Administration, Seattle, WA. http://ccma.nos.noaa.gov/publications/tm62.pdf

NOAA, 1999. Sediment Quality Guidelines developed for the National Status and Trends Program. http://response.restoration.noaa.gov/book_shelf/121_sedi_qual_guide.pdf

NOAA, 2009. Storm Events for California. National Climatic Data Center. http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

Santangelo, R.V., Diehl, D.W. and S.B. Weisberg. 1994. Spatial Characterization of Four Water Column Parameters on the Mainland Shelf of Southern California in July 1994. Southern California Coastal Water Research Project (SCCWRP). ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/AnnualReports/1997AnnualReport/ar09.pdf

Smith, R.W., Bergen, M., Weisberg, S.B., Cadien, D., Dalkey, A., Montagne, D., Stull, J.K., and R.G. Velarde. 2001. Benthic Response Index for Assessing Infaunal Communities on the Southern California Mainland Shelf. Ecological Applications, 11(4), pp.1073-1087.

State Water Resources Control Board. 2005. Water Quality Control Plan, Ocean Waters of California (California Ocean Plan). California State Water Resources Control Board, Sacramento, CA.

Tetra Tech, Inc. 1993. Technical Review. Goleta Sanitary District, California Section 301(h) Application for Modification of Secondary Treatment Requirements for a Discharge into Marine Waters. Prepared by Tetra Tech Inc., Lafayette, CA for U.S. Environmental Protection Agency, Region IX, San Francisco, CA.

USEPA. 1994. Amended Section 301(h) Technical Support Document. EPA 842-B-94-007. U.S. Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds, Washington, D.C.

USEPA. 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 1: Fish Sampling and Analysis. Third Edition. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. http://www.epa.gov/waterscience/fish/advice/volume1/index.html.

USEPA. 2001. Water Quality Criteria: Notice of Availability of Water Quality Criterion for the Protection of Human Health: Methylmercury; Final Rule. U.S. Environmental Protection Agency, Washington, D.C. Federal Register: January 8, 2001, Vol. 66, No. 5, pp 1344-1359. http://www.epa.gov/waterscience/criteria/methylmercury/pdf/mercury-criterion.pdf

USEPA. 2002. Tentative decision document: Goleta Sanitary District application for a modified NPDES permit under section 301(h) of the Clean Water Act. U.S. Environmental Protection Agency, Region IX, San Francisco.

USGS. 2009. Surface Water Monthly Statistics for California. Station 11120000 Atascadero C NR Goleta CA. http://waterdata.usgs.gov/ca/nwis/monthly

APPENDIX A – FIGURES

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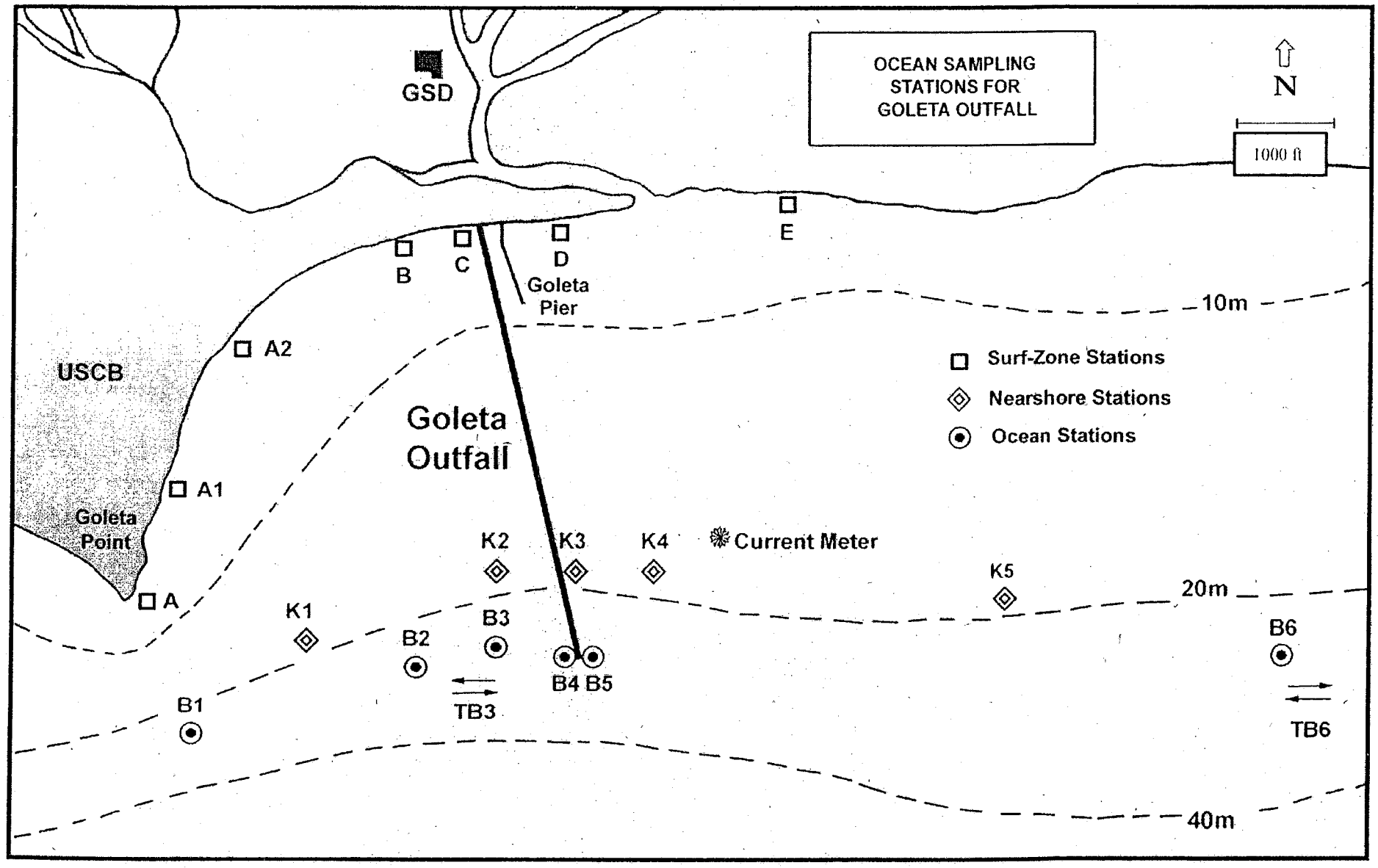


Figure IIB-1. Goleta Sanitary District Receiving Water Monitoring Stations

Figure 1. Total Organic Carbon in Sediment (µg/g)

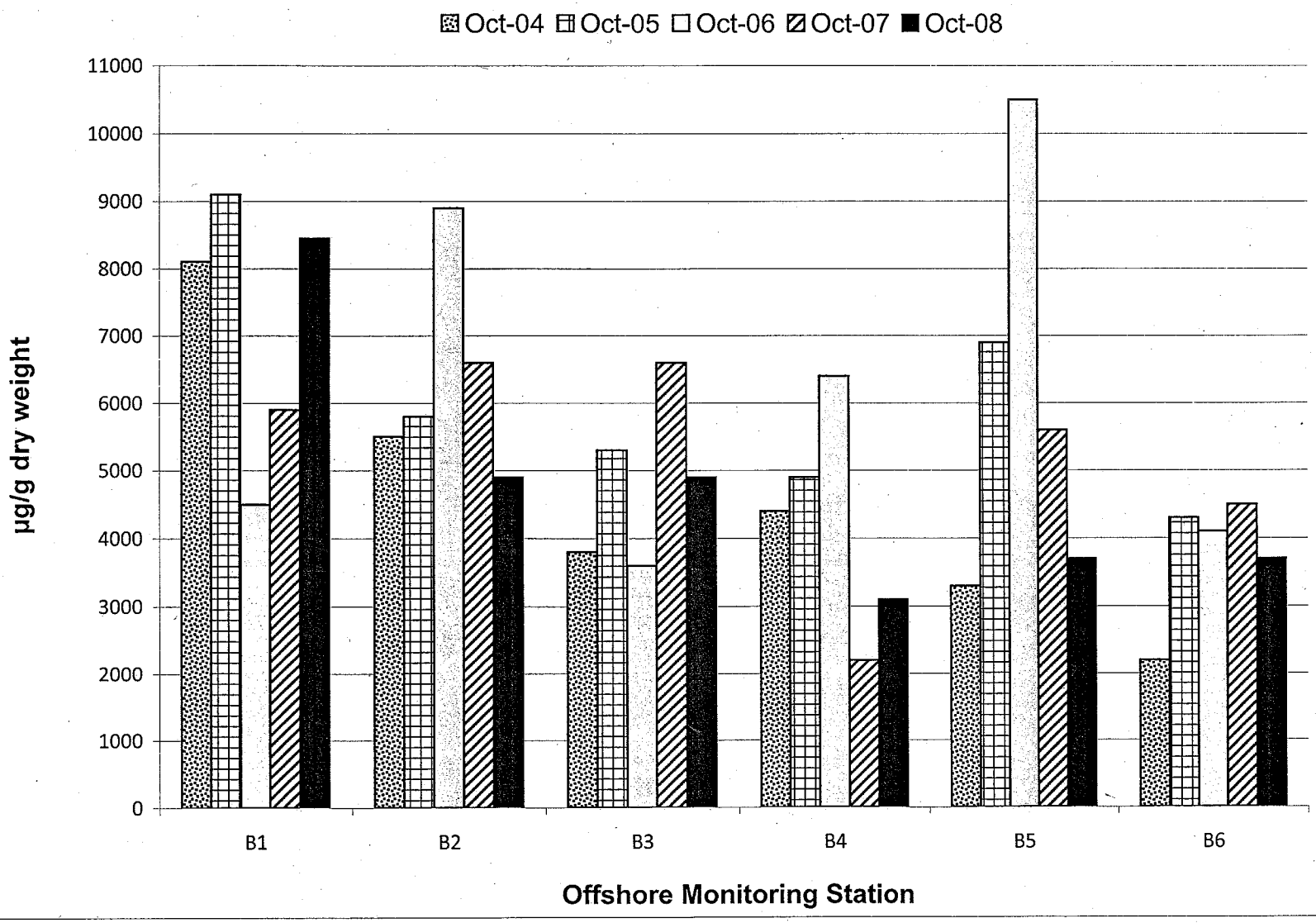


Figure 2. Total Kjeldahl Nitrogen in Sediment (µg/g)

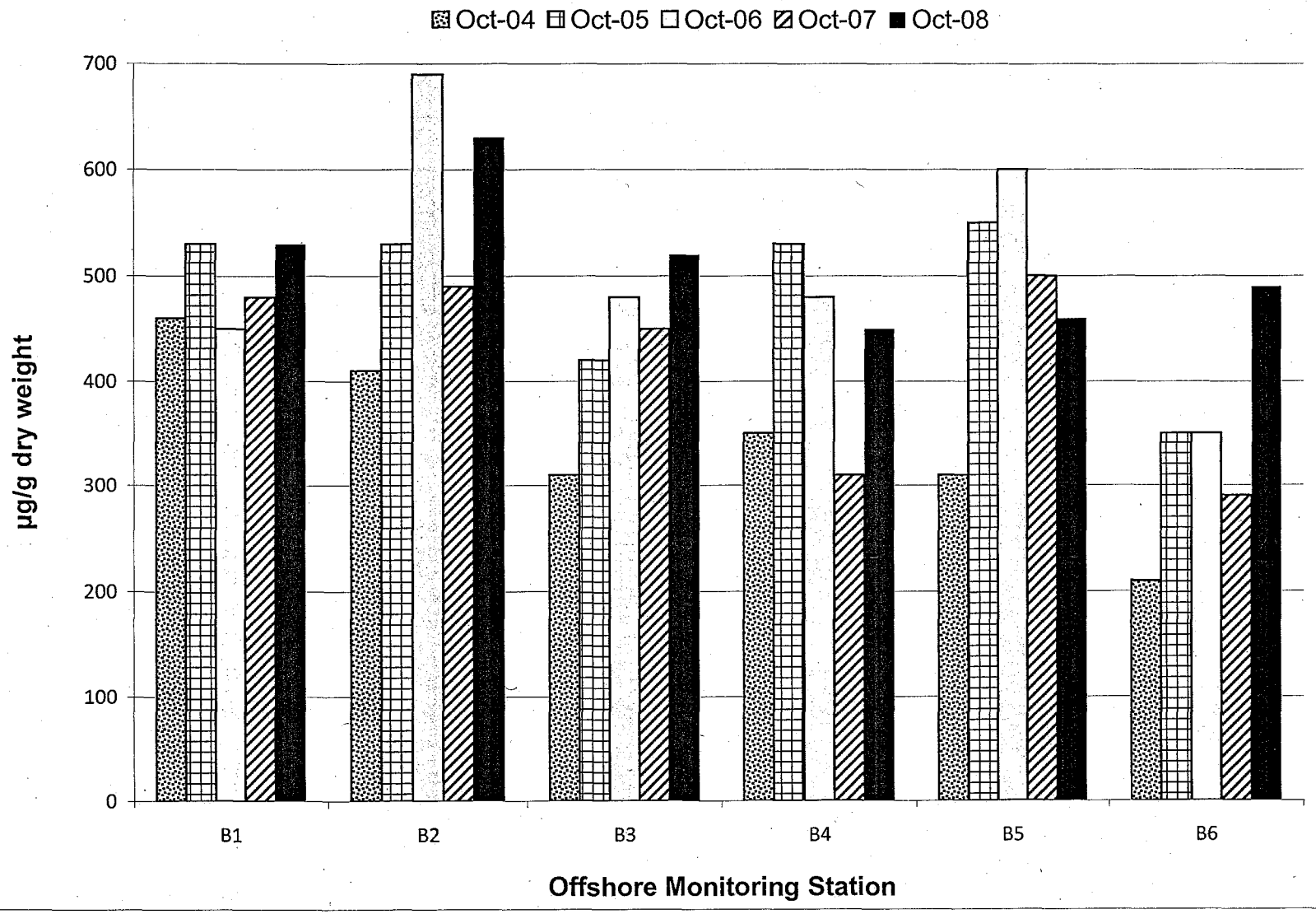


Figure 3. Acid Volatile Sulfide in Sediment (µg/g)

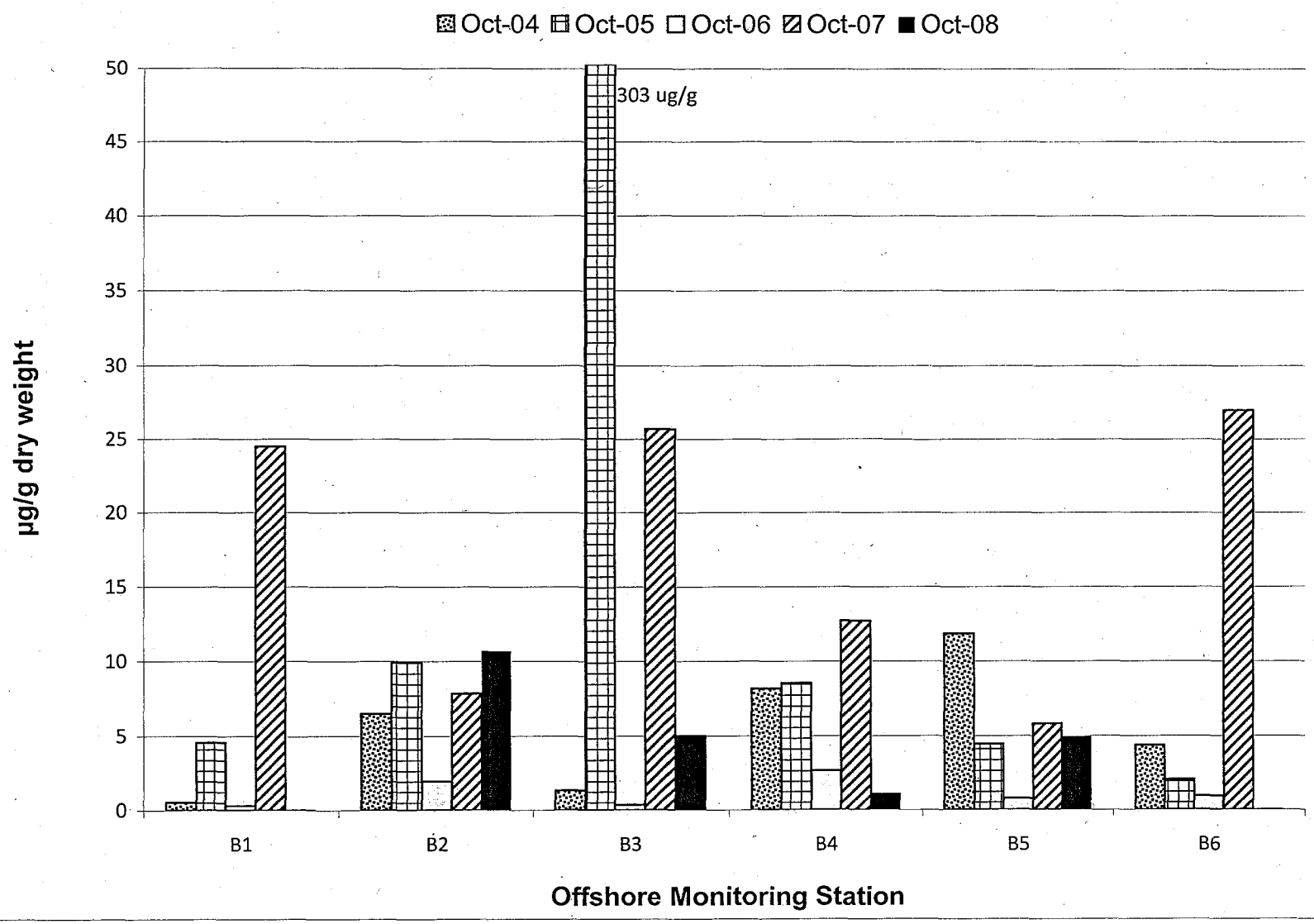


Figure 4. Mercury in Sediment (µg/g)

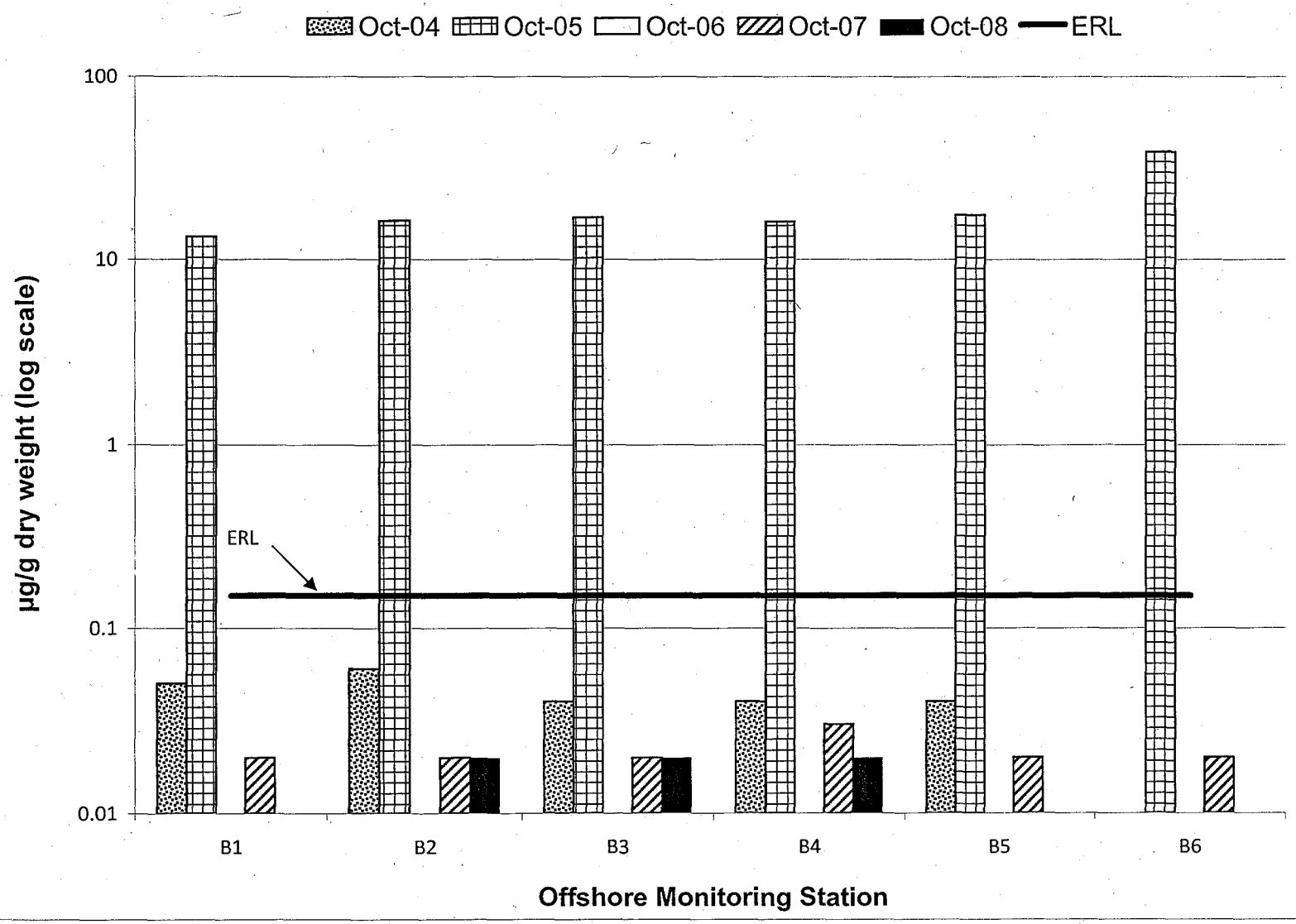


Figure 5. Nickel in Sediment (µg/g)

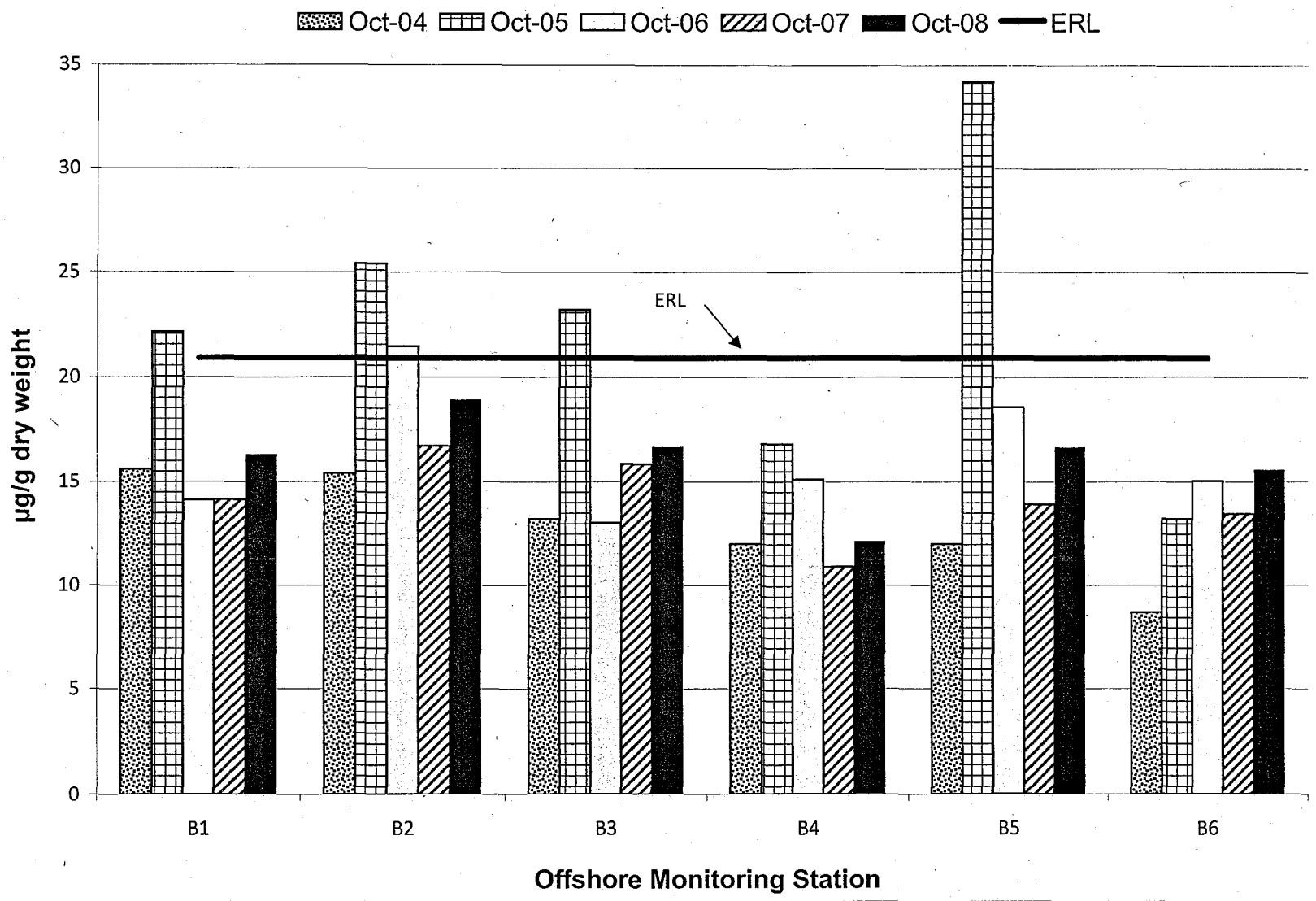


Figure 6. Total DDT in Sediment (ng/g)

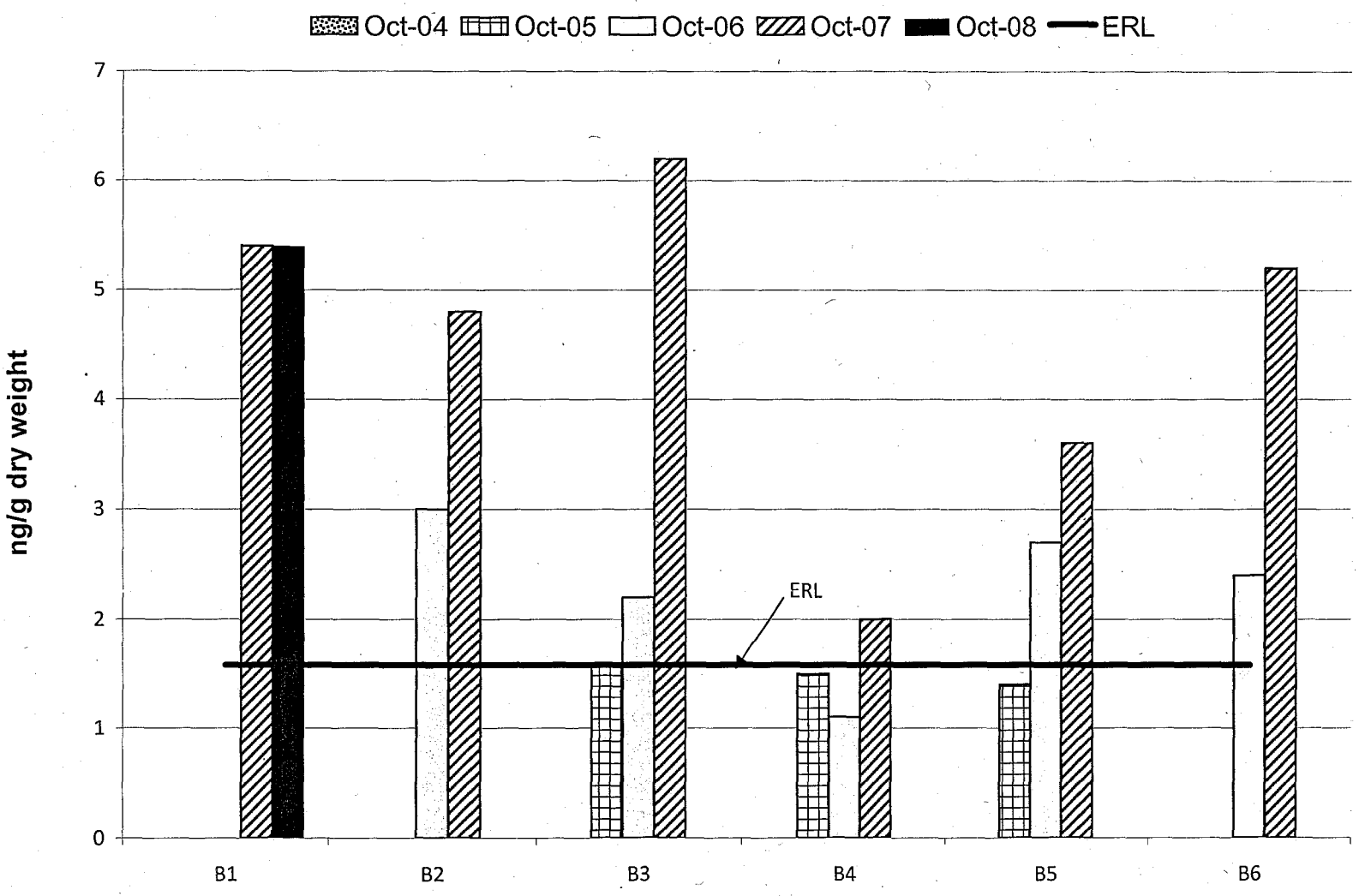


Figure 7. Total PCB concentrations in the liver of Speckled Sanddab collected at offshore trawl stations (2004-2008)

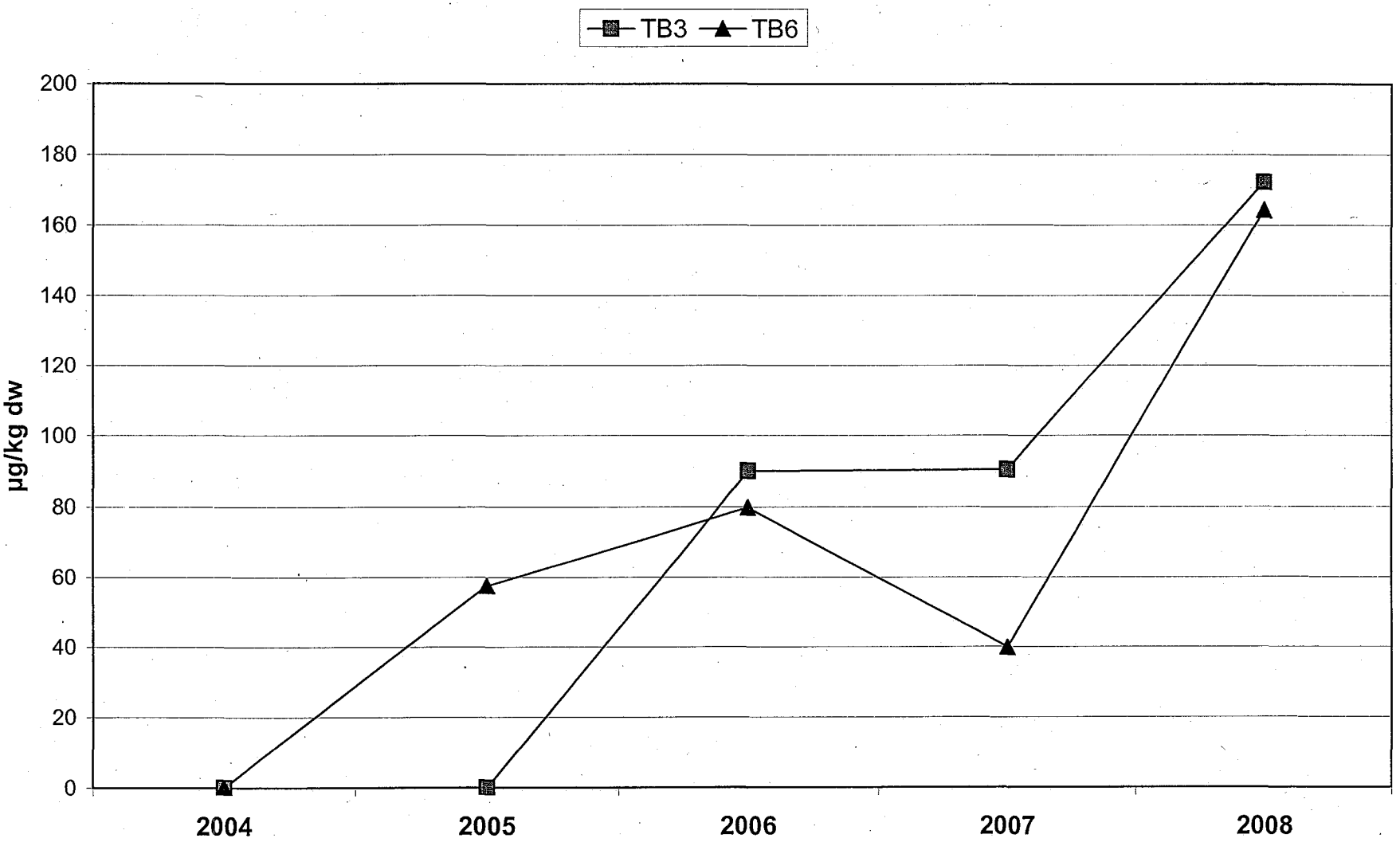


Figure 8. Arsenic concentrations in the muscle tissue of Speckled Sanddab collected at offshore trawl stations (2004-2008)

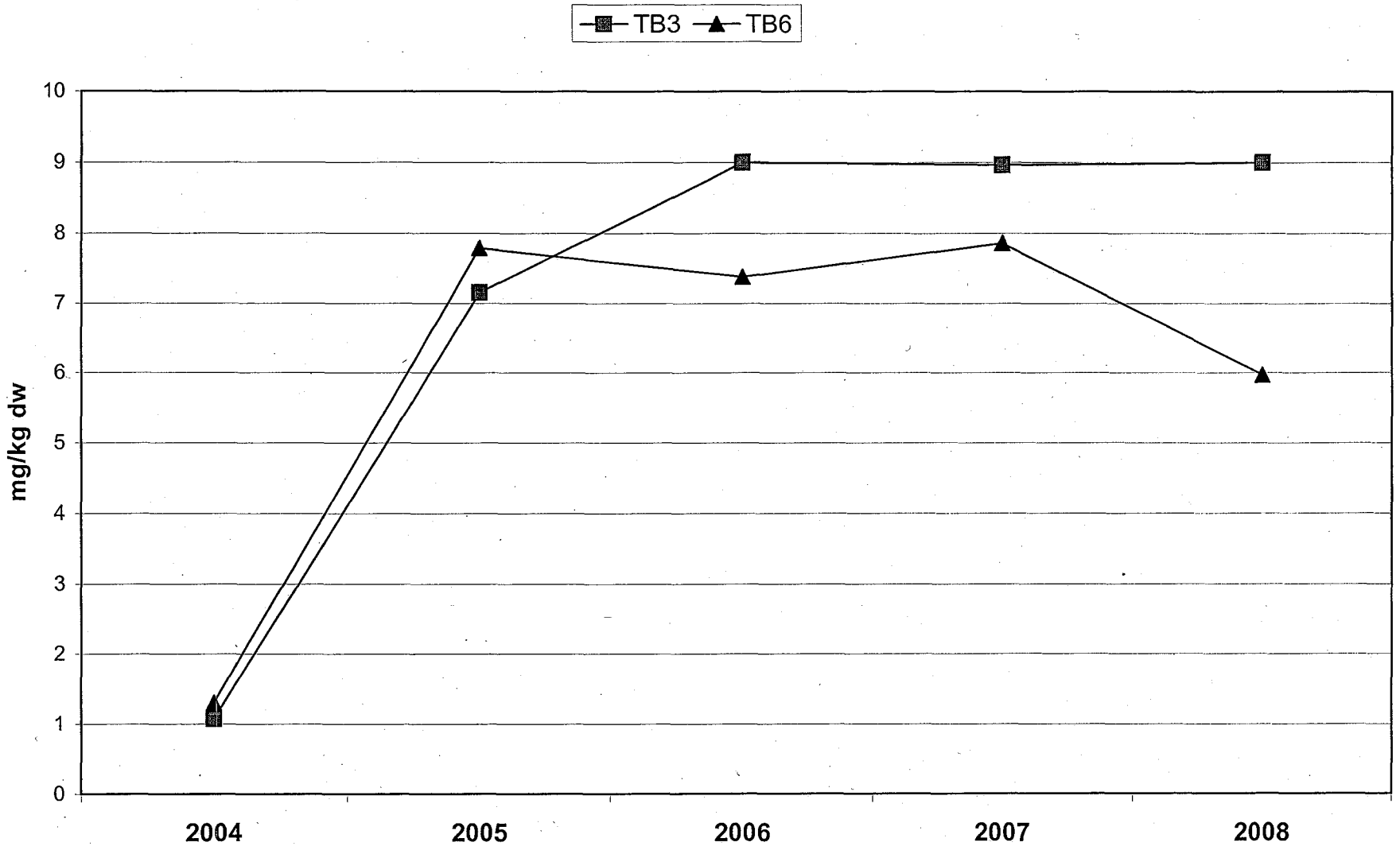


Figure 9. Total PAH concentrations in the muscle tissue of Speckled Sanddab collected at offshore trawl stations (2004-2008)

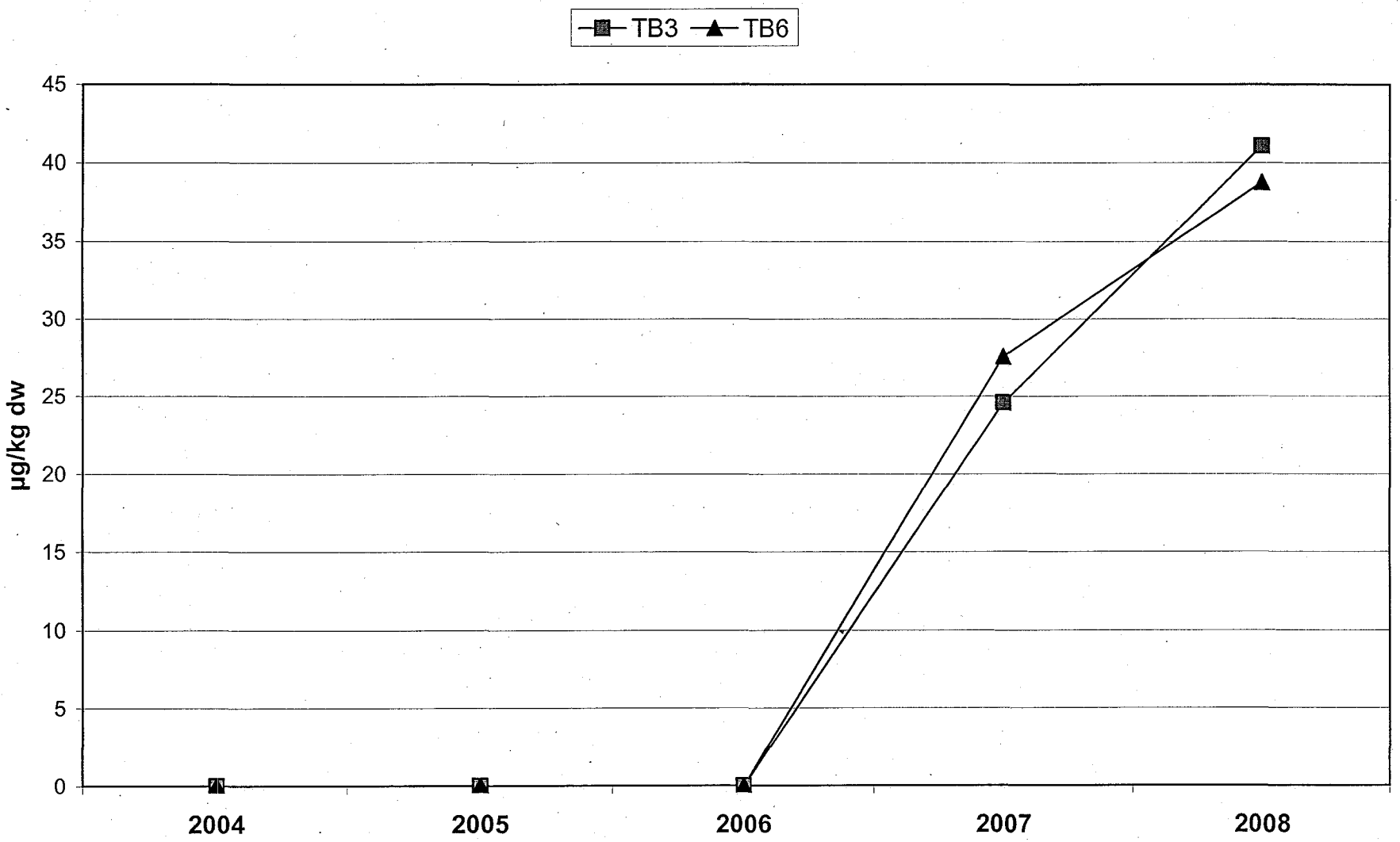


Figure 10. Zinc concentrations in the muscle tissue of Speckled Sanddab collected at offshore trawl stations (2004-2008)

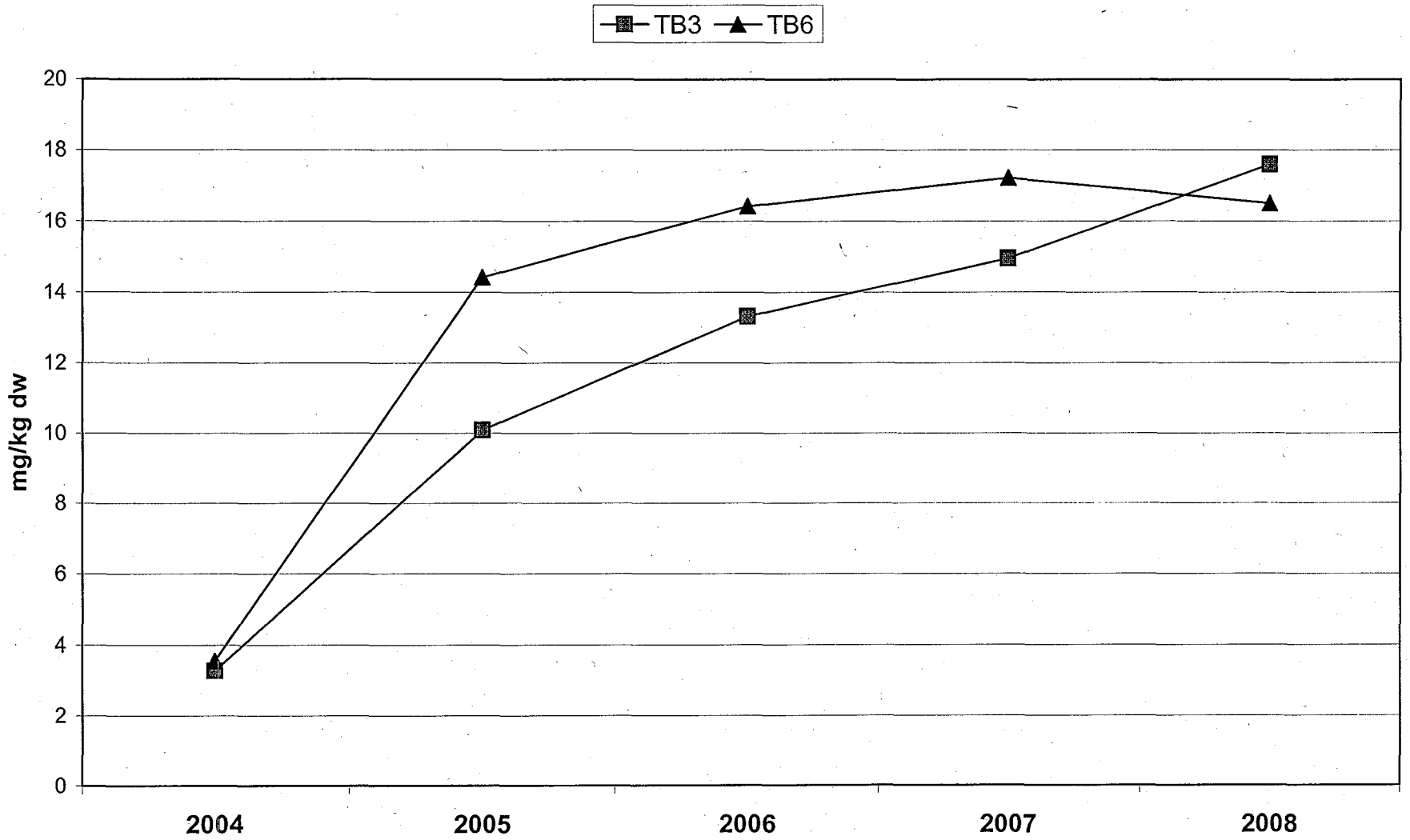
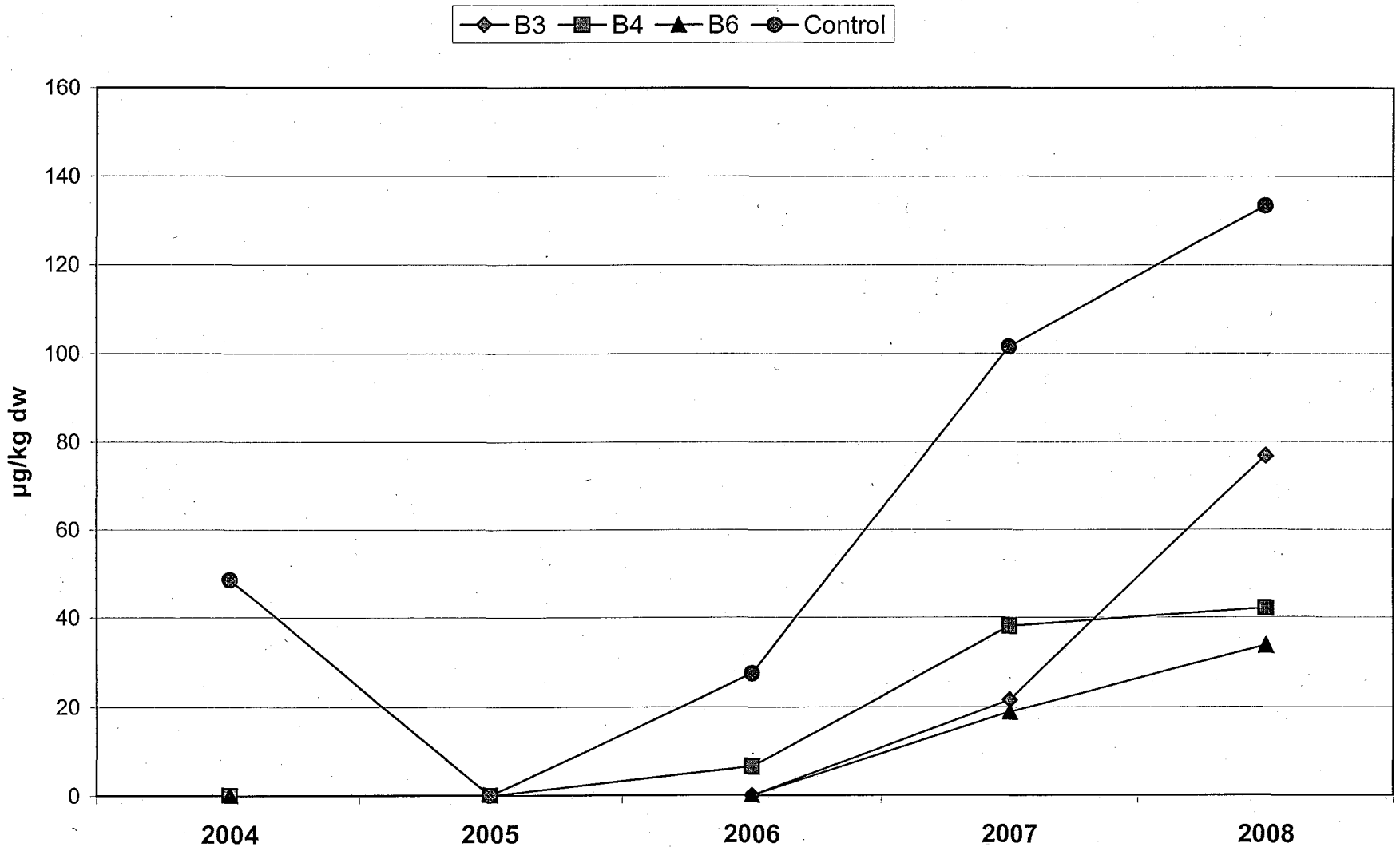


Figure 11. Total PAH concentrations in Whole Bivalve tissue deployed at offshore stations (2004-2008)



APPENDIX B – LIST OF TABLES AND FIGURES