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CALIFORNIA COASTAL COMMISSION

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RECORD PACKET COPY

Filed:	9/25/00
49th Day:	11/13/00
180th Day:	3/24/00
Staff:	AJP-LB
Staff Report:	10/23/00
Hearing Date:	11/14-17/00

STAFF REPORT: REGULAR CALENDAR

APPLICATION NUMBER: 5-00-384

APPLICANT: State of California Department of Transportation- District 7

PROJECT LOCATION: Vincent Thomas Bridge, Port of Los Angeles

PROJECT DESCRIPTION: Permanent installation of 12 (200 to 1,125- watt) floodlights; eight (7,000-watt) fixed pencil beam Xenon lights; approximately 160 (175 watt) marine grade jelly jar light fixtures; glare shields; and eight 8-foot in diameter parabolic reflective discs to an existing bridge (Vincent Thomas Bridge) that spans the northern portion of the main channel of the Los Angeles Harbor.

LOCAL APPROVALS RECEIVED: N/A

SUBSTANTIVE FILE DOCUMENTS: *Technical Report to Assess the potential impacts of the Vincent Thomas Bridge Lighting Project*, by California Department of Transportation, District 7; *Urban Sky Glow and the Lighting of the Vincent Thomas Bridge*, by Kevin W. Houser, PhD.,LC; Categorical Exemption No. 991008 (CEQA).

SUMMARY OF STAFF RECOMMENDATION:

Staff is recommending approval of the proposed development with special conditions addressing protection of migratory bird species by limiting the daily hours of operation and prohibiting the operation during overcast/foggy weather conditions and during the bird's migratory periods.

STAFF NOTE: The proposed project is located within the jurisdictional boundary of the Port of Los Angeles. The proposed coastal development permit application has been submitted to the Commission because the project is not listed in the port master plan as a permitted use. Since the project is not listed in the port master plan the Commission has permit authority. As an improvement to an existing road or highway which is not principally for internal circulation within the port boundaries, the project is an appealable project under Section 30715(a)(3). Therefore, the project

will be evaluated for conformance with the Coastal Act by using the applicable Chapter 3 policies of the Coastal Act.

II. MOTION, STAFF RECOMMENDATION AND RESOLUTION FOR 5-00-384:

Staff recommends that the Commission make the following motion and adopt the following resolution:

MOTION: *I move that the Commission approve Coastal Development Permit* ***#5-00-384*** *pursuant to the staff recommendation.*

STAFF RECOMMENDATION OF APPROVAL:

Staff recommends a **YES** vote. Passage of this motion will result in approval of the permit as conditioned and adoption of the following resolution and findings. The motion passes only by affirmative vote of a majority of the Commissioners present.

RESOLUTION TO APPROVE THE PERMIT:

The Commission hereby approves a permit, subject to the conditions below, for the proposed development and adopts the findings set forth below on grounds that the development as conditioned will be in conformity with the provisions of Chapter 3 of the California Coastal Act and will not prejudice the ability of the local government having jurisdiction over the area to prepare a local coastal program conforming to the provisions of Chapter 3. Approval of the permit complies with the California Environmental Quality Act because either 1) feasible mitigation measures and/ or alternatives have been incorporated to substantially lessen any significant adverse effects of the development on the environment, or 2) there are no further feasible mitigation measures or alternative that would substantially lessen any significant adverse impacts of the development on the environment.

III. STANDARD CONDITIONS:

1. Notice of Receipt and Acknowledgment. The permit is not valid and development shall not commence until a copy of the permit, signed by the permittee or authorized agent, acknowledging receipt of the permit and acceptance of the terms and conditions, is returned to the Commission office.

2. Expiration. If development has not commenced, the permit will expire two years from the date this permit is reported to the Commission. Development shall be

pursued in a diligent manner and completed in a reasonable period of time. Application for extension of the permit must be made prior to the expiration date.

3. Interpretation. Any questions of intent or interpretation of any condition will be resolved by the Executive Director or the Commission.

4. Assignment. The permit may be assigned to any qualified person, provided assignee files with the Commission an affidavit accepting all terms and conditions of the permit.

5. Terms and Conditions Run with the Land. These terms and conditions shall be perpetual, and it is the intention of the Commission and the permittee to bind all future owners and possessors of the subject property to the terms and conditions.

IV. SPECIAL CONDITIONS

1. Period and Hours of Operation

Prior to the issuance of the permit the applicant shall submit a written agreement for review and approval by the Executive Director, that provides that the lights shall operate only between the hours of sunset to 11:00 p.m., except as listed below when the lights are required to remain off:

1) During the fall (August through October) and spring (March through May) migratory bird period.

2) During overcast or foggy weather conditions (horizontal visibility reduced to less than 1,000 meters) throughout the year, the lights shall be turned off and shall remain off until the overcast or foggy conditions have cleared in the area surrounding the bridge.

2. Automated Shut-off System for Overcast/Foggy Weather Conditions

Prior to the issuance of the permit the applicant shall provide evidence, for the review and approval of the Executive Director, that demonstrates that the applicant will incorporate an automated system to measure overcast or foggy weather conditions (horizontal visibility reduced to less than 1,000 meters) and that further shows that the measurements will be incorporated into the automated operating light system so that when overcast or foggy weather conditions arise at the bridge the lights will automatically shut-off and will remain off until the overcast or foggy conditions have dissipated.

3. Future Bird Mortality

The applicant shall agree in writing, subject to the review and approval of the Executive Director, if any significant mortality of birds is observed, the lights shall be turned off immediately until the Coastal Commission, California Department of Fish and Game, and the U.S. Fish and Wildlife Service are notified and an appropriate course of action is identified by the three agencies. The course of action may include the permanent discontinuance of the lights. Based on the course of action identified by the agencies, the Executive Director shall determine if an amendment to this permit is required.

V. FINDINGS AND DECLARATIONS:

The Commission hereby finds and declares:

A. Project Description and Location

The applicant is proposing to permanently install 12 (200 to 1,125 watt) floodlights; eight (7,000-watt) fixed pencil beam Xenon lights; approximately 160 (175 watt) marine grade jelly jar light fixtures; glare shields; and eight 8-foot in diameter parabolic reflective discs to an existing bridge (Vincent Thomas Bridge) that spans the northern portion of the main channel of the Los Angeles Harbor (see Exhibit No. 1 & 2).

The twelve floodlights and eight fixed pencil beam Xenon lights will be located along the two bridge towers. Eight floodlights will be located at the lower strut, near the base of the towers, and will light the underside of the bridge. Four floodlights will be located at midheight to illuminate parabolic art disks located on each tower at the midheight level. The eight Xenon lights will be located along the outermost side of each tower at the midheight level. One Xenon light will direct light up along the outermost side of the tower, and another Xenon light will direct light down the tower (see Exhibit No. 4 and 9). At the top of each tower there will be a decorative convex art piece (shield) that will prevent any light from spilling into the atmosphere (see Exhibit No. 6). All floodlights and Xenon lights are proposed with 360-degree glare shields.

The 160 marine grade jelly jar light fixtures will be located along the horizontal span, below the roadway (see Exhibit No. 4 & 8).

The location and direction of the lighting, as proposed, will result in the illumination of the entire outermost side of each tower and the horizontal span. All proposed lighting is for decorative purposes to visually enhance the bridge at night.

The Vincent Thomas Bridge crosses over the northern portion of the Los Angeles Main Channel in an east-west direction, connecting the San Pedro area of the City of Los Angeles with Terminal Island in the Port of Los Angeles (see Exhibit No.1). The bridge is a 4-lane suspension bridge built in 1963. The bridge is 1,500 feet long between towers, with back spans of approximately 506 feet on either side (see Exhibit No. 2). The two bridge towers consists of two columns or spires. The towers are located on land on either side of the Los Angeles Main Channel. The towers extend to a height of 335 feet above ground level (335 feet above sea level). The area immediately surrounding the bridge is primarily industrial, with cruise ship docks, cargo loading and storage yards and other port related facilities.

The bridge is part of State Route 47, which is under the jurisdiction of the California Department of Transportation, who is the applicant of this project. The sponsors of the project are the City of Los Angeles, Los Angeles Harbor Department, Department of Water and Power, Vincent Thomas Bridge Lighting Committee, and the Shuwa Corporation.

As an improvement to an existing road or highway, which is not principally for internal circulation within the port boundaries, the project is an appealable project under Section 3015(a)(3) of the Coastal Act. As an appealable project and a project located within the jurisdiction of the port, the project will be evaluated for conformance with the Coastal Act by using the applicable Chapter 3 policies of the Coastal Act.

A similar project was before the Commission in November 1999 (Coastal Development Permit application #5-99-377). The project in 1999 included 120 floodlights to light the horizontal span and towers, and 4 Xenon lights located atop each tower to direct light straight into the sky. The initial lighting was to be permanent, with lights intended to be on nightly from approximately sunset to sunrise.

The Dept. of Fish and Game and the Fish and Wildlife Service verbally expressed to staff initial concern with the lighting of the bridge and the potential adverse impact on migratory birds. During the public hearing the Commission heard public testimony from a number of environmental and astronomical groups and scientists that expressed concerns with regards to the light impacts. Because of concerns with potential impacts to birds and potential visual impacts, due to increase illumination, the Commission denied the permit application.

Based on these concerns and the Commission action, the City of Los Angeles and Caltrans has had numerous meetings and discussions with the Dept. of Fish and Game and the Fish and Wildlife Service, the environmental and astronomical groups that initially expressed concern with the project, and Commission staff. From the information and input from these meetings the City of Los Angeles and Caltrans revised the lighting design

to address the concerns that had been raised. The proposed project that is before the Commission is a product of the City's and Caltrans effort to design a project that is sensitive to those concerns.

B. Environmental Resources

Chapter 3 Polices

Section 30230 of the Coastal Act states:

> Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes.

Section 30240 of the Coastal Act states in part:

> (a) Environmentally sensitive habitat areas shall be protected against any significant disruption of habitat values, and only uses dependent on those resources shall be allowed within those areas.
>
> (b) Development in areas adjacent to environmentally sensitive habitat areas and parks and recreation areas shall be sited and designed to prevent impacts which would significantly degrade those areas, and shall be compatible with the continuance of those habitat and recreation areas.

The issue the proposed project raises is the potential impact the lights may have on the various bird species that migrate through the harbor, resident bird species, and to fish within the harbor.

The harbor and surrounding area is located along the Pacific Flyway. The Pacific Flyway is the path that migratory birds follow along the Pacific Coast during their annual migrations. Millions of shorebirds and waterfowl travel between northern breeding grounds and southern wintering sites. The Pacific Flyway originates in Western Alaska, around the Yukon River Delta, and extends as far south as Latin America. The peak periods for migration through southern California are March through May and August through October.

Both migratory shorebirds and neotropical songbirds either come to this area to breed or pass through here on their way to other locations. While the majority of shorebirds

migrate during the day, there are some that fly at night. Most songbirds are nocturnal migrants. Wetlands and coastal bays are stopover sites for resting and feeding birds.

According to the applicant a list of approximately 340 species of birds that have been seen at or near Ken Malloy Harbor Regional Park (located about 3 miles northwest of the Vincent Thomas Bridge) has recently been compiled from a variety of sources (Heindel, 2000). This list was cross-checked with a list of neotropical migrant birds (Rappole, 1995) to identify the migrant species that are likely to fly in the vicinity of the Vincent Thomas Bridge. Exhibit 10.b. provides a list of birds likely to be found in the area. According to the applicant, of the species listed, most of the song birds, a large number of the waterfowl and shorebirds, and a variety of other types of birds are nocturnal migrants (Kerlinger and Moore, 1989).

Although there are no available specific studies about the nocturnal migrants and numbers of birds that fly over the harbor area, approximately 100,000 to 1,000,000 birds use Seal Beach, which is approximately 20 miles to the south, as a major stopover, according to the Caltrans technical report (see Exhibit No.10a).

In addition to the migratory birds that may fly through the area, the bridge itself is also home to a pair of American peregrine falcons (falco peregrinus). According to the Caltrans report the peregrines nest/roost on the steel-girders below the bridges' roadway between the two towers. The peregrine was recently removed from the federal endangered list. However, the peregrine is still protected under the federal Migratory Bird Treaty Act. As such, it is considered illegal to harm, harass or kill individuals of this species. The peregrine is also on the State's endangered list. The state Endangered Species Act protects listed species from being killed or harmed.

There have been many studies and reports that indicate that lights on tall structures can pose a problem for night migrating birds and cause mortalities among these birds (i.e. *Collision Course: The Hazards of Lighted Structures and Windows to Migrating Birds*, L.J.E. Ogden, September 1996; *The Effects of Overcast Skies on the Orientation of Free-flying Nocturnal Migrants,* K.P. Able, 1982; *The mechanisms of the trapping effect of artificial light sources upon animals*, F.J. Verheijen, Netherlands Journal of Zoology, 1958). However, studies that have been done are generally associated with tall (over 200 feet) communications towers that are generally located in rural sparely lit areas.

Mortalities associated with tall structures are referred to as tower-kills. These tower-kills have also been known to involve lighted monuments (e.g. the Washington Monument), smoke stacks and airport ceilometers. Most of the reports from the United States come from the eastern and central part of the county. There is no documentation regarding lighted bridges over waterways and the impacts to birds. However, this could be due to birds hitting bridge structures and falling into the water or being removed quickly by scavengers. Therefore, any mortality may go unnoticed.

Although it is not known for certain why birds fly into tall-lighted structures there is a significant amount of data that indicates that tall-lighted structures cause bird kills. The cumulative impact of illuminating additional structures in a highly developed and lighted area is also not known at this time.

The impact to the peregrine should not be significant since the birds nest/roost under the roadway within the bridge girders which will not be illuminated. The Caltrans report states that a peregrine expert and consultant/monitor for the Vincent Thomas Bridge seismic retrofit project, indicated that the proposed lighting would not adversely impact the peregrines. The Dept. of Fish and Game and Fish and Wildlife Service have reviewed the light design and have determined that there will be no significant impact to the peregrines or to fish that may be found in the channel.

According to reports, the birds most affected by lit towers are the neotropical migratory songbirds, in particular thrushes, vireos, and warblers. According to existing reports, there are two mechanisms for bird mortality that occur at communication towers. The first is when birds flying in poor visibility do not see the structure. Communication towers that are lighted at night for aviation safety may help reduce bird collisions caused by poor visibility, but the lights bring about a second mechanism for mortality. When there is a low cloud ceiling or foggy conditions, lights on a tower refract off water particles in the air creating an illuminated area around the tower. Migrating birds have lost their stellar cues for nocturnal migration in these weather conditions. When passing the lighted area, the increased visibility around the tower may become the strongest cue the birds have for navigation, and thus they tend to remain in the lighted space by the tower. Mortality may occur when they run into the structure and its guy wires, or even other migrating birds as more and more passing birds cram into the relatively small, lighted space. Other birds may fly around in circles around the light source until they become exhausted and fall from the sky.

The exact magnitude of the problem is unknown. The Caltrans report states that on January 22, 1998, in western Kansas, an estimated 10,000 Lapland lonspurs were killed at, and in the vicinity of, three towers and a natural gas pumping facility.

In Florida, a 25-year study on bird mortality associated with a communication tower just north of Lake Iamonia, was conducted by ornithologists stationed at a nearby research station. Over the 25-year period, 42,386 birds were found scattered beneath the tower (*Blinking lights mark scenes of death for birds*, by Jim Cox, Tallahassee Democrat).

The Caltrans report states that:

> Many other incidents involving up to, and in some cases more than, 1,000 birds are noted in an annotated bibliography prepared by the U.S. Fish and Wildlife Service's (the Service) Office of Migratory Bird Management (Trapp,

1998). In 1979, the Service estimated an annual mortality at around 1.4 million birds (Manville, 1999). Today's conservative estimate is upwards of 4 million birds killed per year.

The Vincent Thomas Bridge is currently lit with flashing red navigational lights on the top of each bridge tower. According to reports, birds are thought to be less sensitive to flashing red lights than to other forms of light. The Caltrans report indicates that bridge maintenance crews have not reported finding any dead birds near or on the bridge. However, the report further states that it is possible that any existing problem would go unnoticed because the birds could fall in the water or be quickly removed by scavengers.

As stated, the Port of Los Angeles is developed with numerous industrial and port related facilities. With such development there are numerous lights throughout the Port area. These lights are located on/in buildings, on cargo cranes that extend to approximately 150 feet in height, and large multi-acre parking and cargo storage lots.

Based on visual observation, the port area surrounding the two towers is well lit (see arial photographs, Exhibit No. 17a., b. & c.) due to 24 hour port operations and safety concerns. The applicant has submitted a recent light report (*Urban Sky Glow and the Lighting of the Vincent Thomas Bridge*, Kevin W Houser, Ph.D) that was prepared for the applicant, to address the issue of the amount of light the project will create in the area (see No. 11). The study involved: 1) direct measurements of sky luminance in the region around the Port of Los Angeles, and 2) estimation of the increase in sky glow at Palomar Observatory that would likely result from the proposed lighting.

Based on the information compiled, the report concludes that based on direct quantitative measurements the sky above the Port of Los Angeles is considerably brighter than the sky in the surrounding areas. Because of the existing light conditions at the port, the report indicates that the increase in urban sky glow as a result of the proposed project would not be significant. Using an empirical formula ("Walkers Law") to estimate urban sky glow the report estimates that the sky glow would increase by 0.029%. According to the report, the estimate is based on conservative assumptions and using more realistic assumptions the actual increase would be less than 0.008%.

According to reports on sky glow, there are two mechanisms that contribute to increases in sky glow: 1) an increase in atmospheric particulates, and 2) additional lighting spilling into the atmosphere. The report prepared for the project states that if lighting is held constant, the magnitude of sky glow is a function of the atmospheric conditions at any fixed ground location. An increase in atmospheric particulates may result from an increase in pollution, clouds, humidity, and/or other airborne matter.

As stated, the area surrounding the Vincent Thomas Bridge is a highly developed industrial area and is brightly illuminated. The lighting in the port is generally with high/low

pressure sodium lights that produce light in wavelengths in yellow or orange light. These type of lights are used because the light within this wavelength travels farther in fog and haze. The lights proposed to light the bridge structure will be metal halide and xenon sources that produce a white light. This type of light was chosen over the more efficient high/low pressure sodium lights to minimize the amount of sky glow. The Jelly Jar light fixtures will be provide a soft low intensity blue light.

Based on the lighting report, the additional lighting will not significantly increase the overall sky glow in the area. However, the use of any light will still produce stray light. The amount of stray light can be minimized by the type of lights used, directional orientation, and shielding. As proposed the applicant has designed the lighting with good optics, is focusing light directly on to the structure, and providing 360 degree glare shields. With these proposed measures the amount of light escaping into the atmosphere will be significantly reduced. However, even with responsible design, light will invariably spill into the surrounding atmosphere and the amount of sky glow will increase with an increase in atomospheric particulates, such as during over-cast or foggy conditions.

The Fish and Wildlife Service, and environmental groups, have expressed concerns with the lights during these periods of inclement weather, which creates the greatest potential impact to migratory birds. To address this issue the applicant is proposing additional measures that will further minimize the amount of sky glow during overcast or foggy conditions, and during the fall and spring neotropical bird migratory periods. To ensure that the lights will not adversely impact birds during overcast or foggy conditions, the applicant is proposing to turn off the lights during foggy conditions that may occur throughout the year. The applicant has indicated that weather conditions will be monitored at the port and the lights will be turned off manually or electronically if overcast/foggy weather conditions are observed by bridge maintenance staff [By definition, fog is present when small water droplets near the ground are dense enough to reduce horizontal visibility to less than 1 km (5/8 mile)]. However, if determining weather conditions is based on an individual's visual observation, there is the possibility of error and/or neglect. To ensure that the lights will be turned-off during foggy conditions the lighting system needs to be connected to a measuring device that will automatically shut off the lights when foggy conditions arise. Therefore, a special condition is necessary to require the applicant to provide prior to the issuance of the permit, evidence demonstrating that the lighting system can be electronically connected to a devise that measures fog or water content in the air and will automatically shut off the lights when fog is present.

The applicant is also proposing to limit the hours of operation from sunset to 11:00 p.m. throughout the year, to avoid the peak migratory hours, which generally occur after 11:00 p.m. The lighting system will be connected to an astronomical clock that will turn the lights on at sunset, which varies depending on time of year, and off at the designated time. The applicant has also indicated that the lights will be turned off in a staggered sequence to allow birds, that may be in the area, to gradually adapt to the changing illumination.

Fish and Wildlife Service and the Dept. of Fish and Game have reviewed these proposed mitigation measures and have determined that with the mitigation measures the proposed project will not have a significant impact to wildlife.

Therefore, based on the information provided, a special condition is necessary to require that the applicant will incorporate an operation plan that would limit the hours of operation to not exceed 11:00 p.m. on a nightly basis, to avoid operation during the fall and spring bird migratory periods, and to shut off the lights during periods of overcast or foggy environmental conditions. Furthermore, in the event that there is any significant mortality of birds, the lights shall be turned off immediately until the Coastal Commission, the California Department of Fish and Game and the U.S. Fish and Wildlife Service are notified and an appropriate course of action is identified. The Commission finds that, only as conditioned by this permit, will the project minimize any substantial adverse environmental impacts and be consistent with Section 30230 and 30240 of the Coastal Act.

C. California Environmental Quality Act

Section 13096 of the Commission's regulations requires Commission approval of Coastal Development Permit applications to be supported by a finding showing the application, as conditioned by any conditions of approval, to be consistent with any applicable requirements of the California Environmental Quality Act (CEQA). Section 21080.5(d)(2)(i) of CEQA prohibits a proposed development from being approved if there are feasible alternatives or feasible mitigation measures available, which would substantially lessen any significant adverse effect which the activity may have on the environment.

The proposed project, as conditioned, has been found to be consistent with the Chapter 3 policies of the Coastal Act. All adverse impacts have been mitigated by conditions of approval and there are no feasible alternatives or feasible mitigation measures available which would lessen any significant adverse impact the activity may have on the environment. Therefore, the Commission finds that the proposed project, only as conditioned, is consistent with CEQA and the policies of the Coastal Act.

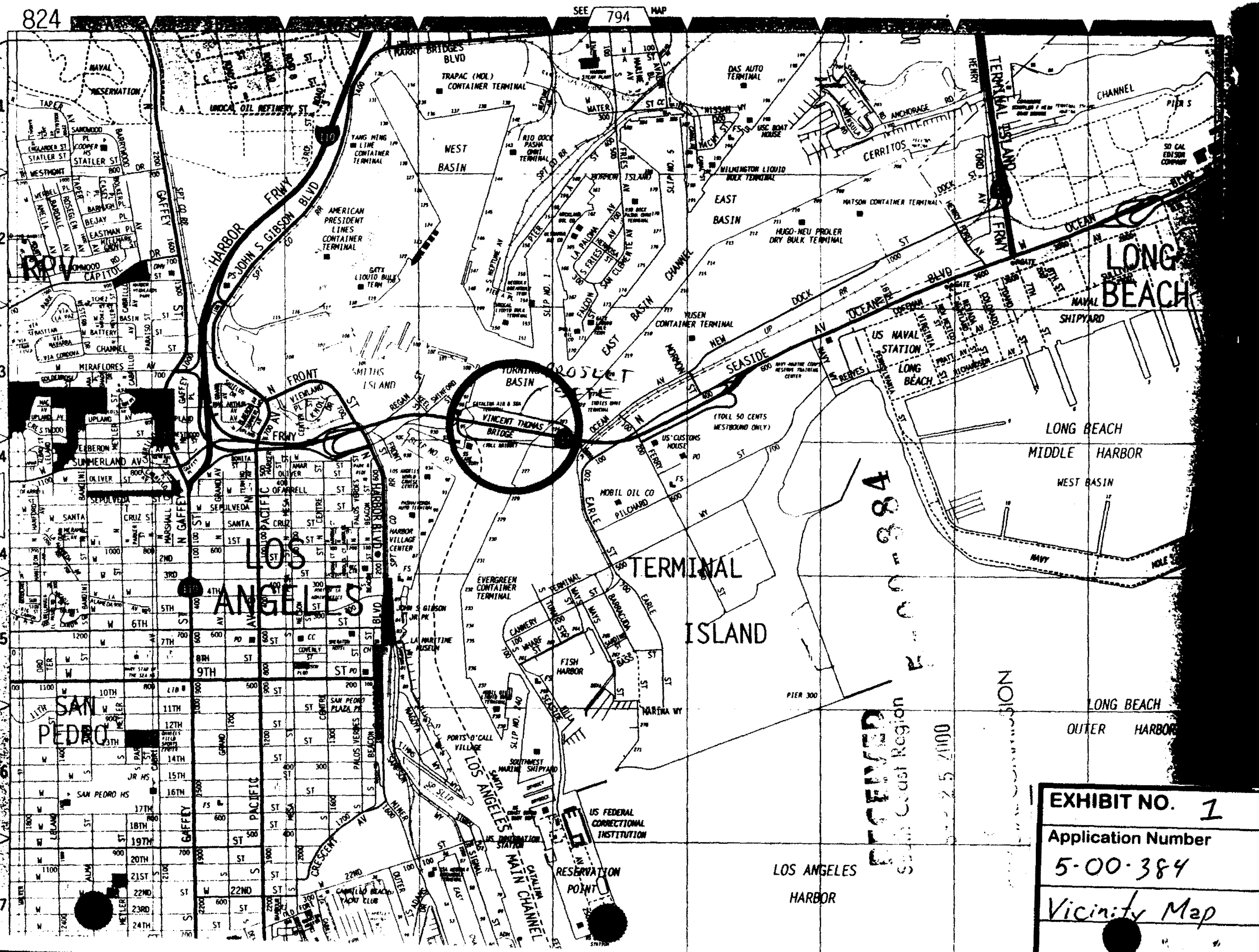


EXHIBIT NO. 1

Application Number

5-00-384

Vicinity Map

California Coastal Commission

THE PREVIOUS DESIGN

1. DELETE ALL LIGHTING FROM THE TOP OF THE BRIDGE AND RELOCATE THE GOLD DISCS TO THE MID-POINTS OF THE TOWERS.
2. REDUCE THE QUANTITY OF FIXTURE AT THE MIDPOINT OF THE TOWERS.
3. DELETE THE FLOODLIGHTS AT THE BASE OF THE TOWER THAT WERE USED TO LIGHT THE VERICAL PLANE.

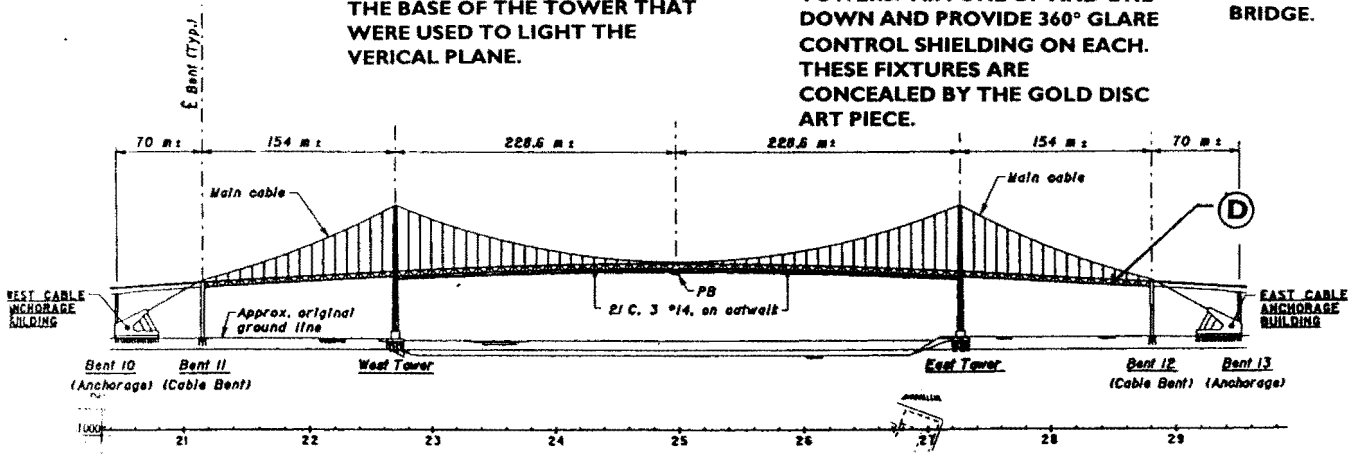
THE NEW PROPOSAL

A. CREATE A DECORATIVE CONVEX PIECE AT THE TOP OF THE TOWER THAT CANTELEVERS OVER THE SIDE TO ABSORB ANY SPILL LIGHT INTO THE ATMOSPHERE FROM NEW CONCEPT B.

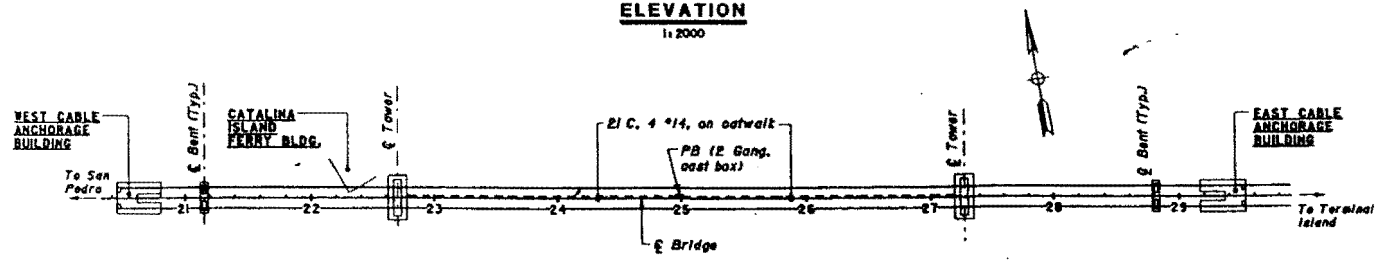
B. USE ONLY 2 PENCIL BEAM LIGHT FIXTURES TO ILLUMINATE THE OUTERMOST SIDE OF THE TOWERS. AIM ONE UP AND ONE DOWN AND PROVIDE 360° GLARE CONTROL SHIELDING ON EACH. THESE FIXTURES ARE CONCEALED BY THE GOLD DISC ART PIECE.

C. ELIMINATE 52 FLOODLIGHTS ON THE UNDERSIDE OF THE BRIDGE. THE 8 THAT ARE TO REMAIN WILL HAVE 360 DEGREE SHIELDING AND WILL BE AIMED DIRECTLY AT THE STRUCTURE.

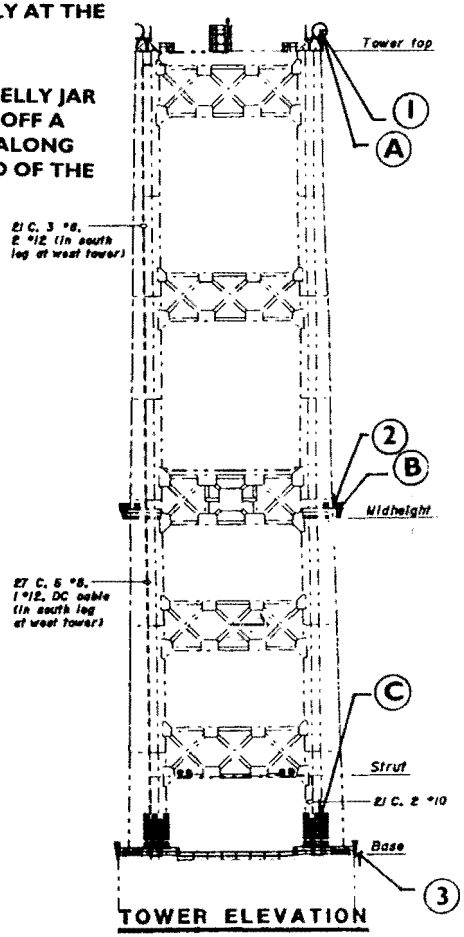
D. APPLY COLBALT BLUE JELLY JAR FIXTURES, WHICH GIVE OFF A SOFT POINT OF LIGHT, ALONG THE HORIZONTAL BAND OF THE BRIDGE.



ELEVATION
1:2000



PLAN
1:2000



TOWER ELEVATION

EXHIBIT NO. 2

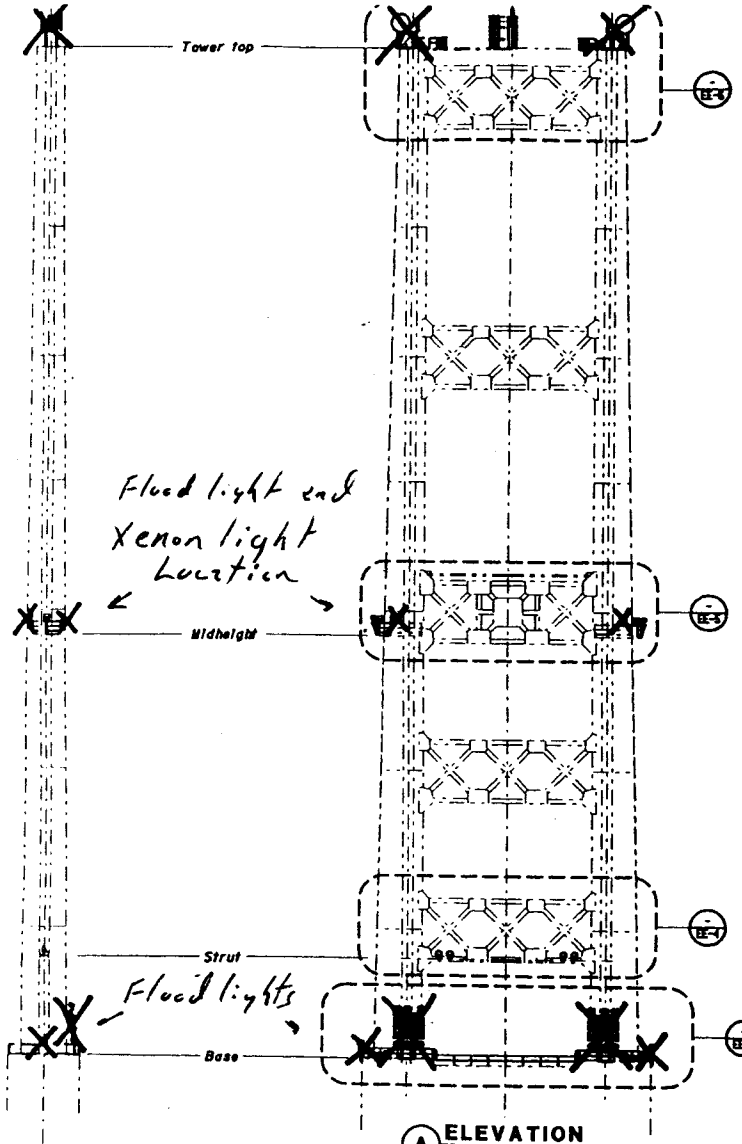
Application Number

5-00-384

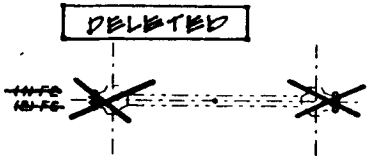
Previous & New Desig

Plan

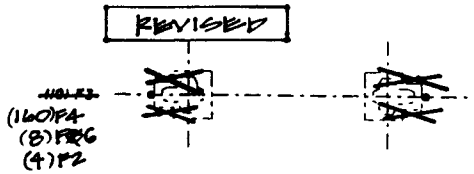
California Coastal Commissi



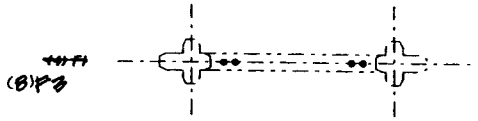
A ELEVATION
1:250
(East tower shown; west tower similar)



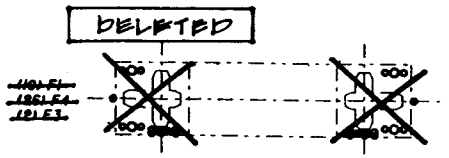
TOWER TOP



MID-HEIGHT



STRUT



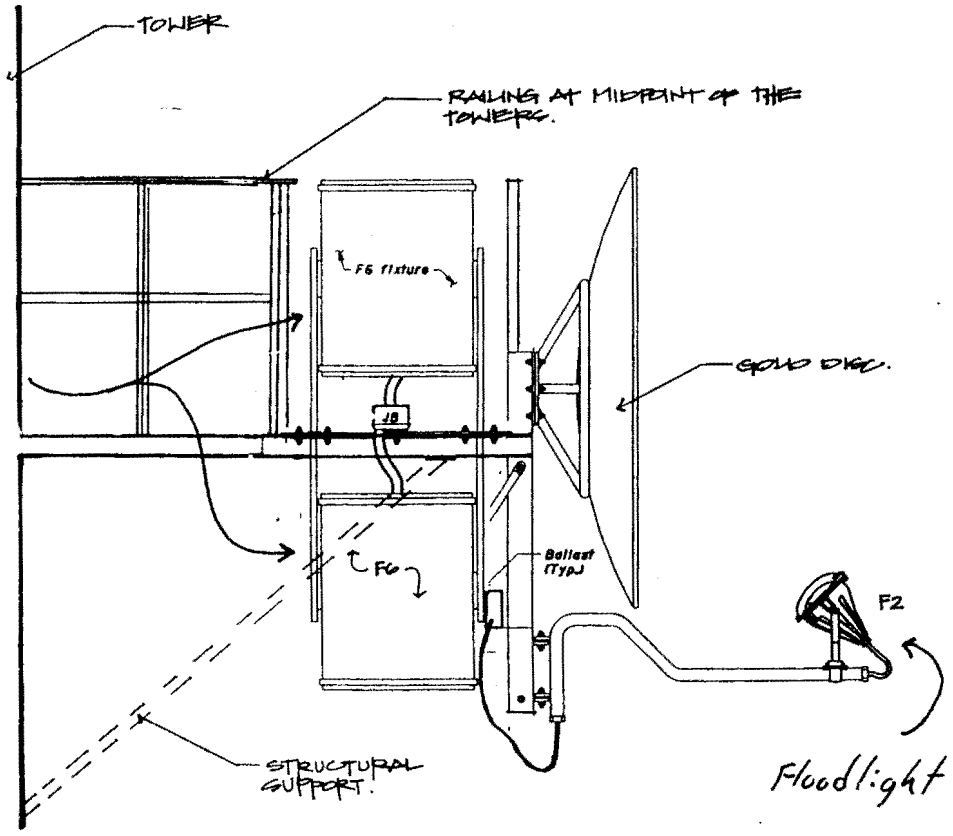
BASE

LAYOUT PLAN
1:250

SEE ATTACHED FIXTURE SCHEDULE FOR FIXTURE INFORMATION

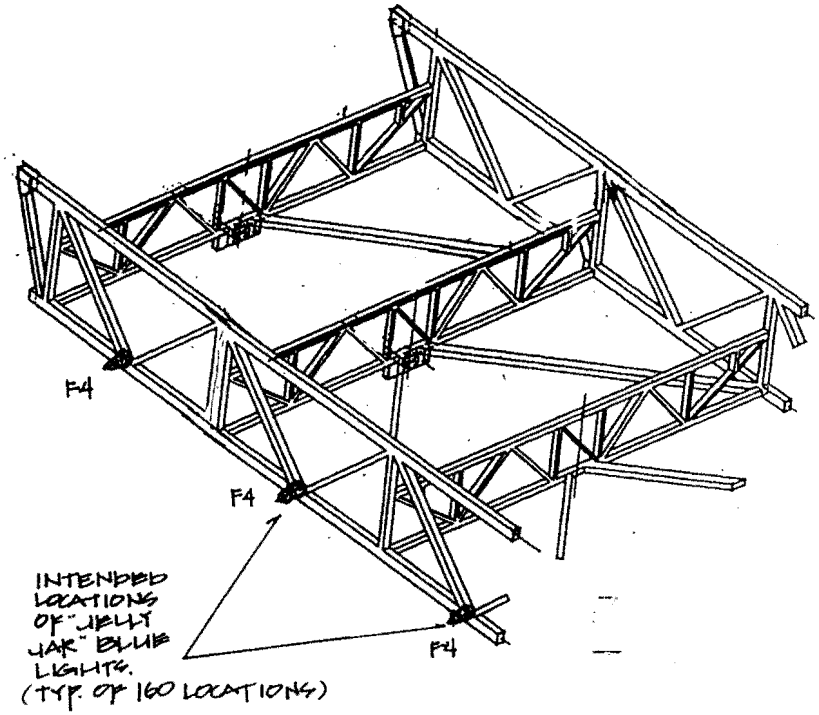
EXHIBIT NO. 3
Application Number
5-00-384
Tower Elevation

California Coastal Commission



REVISED DETAIL OF THE LIGHT FIXTURES AT THE MID-POINT OF THE TOWERS

(A) **ELEVATION**
1:10



ISOMETRIC SHOWING LOCATION OF BLUE JELLY JAR FIXTURES TYPE F4

♦PRELIMINARY- SUBMITTED FOR APPROVAL ♦

EXHIBIT NO. 4

Application Number

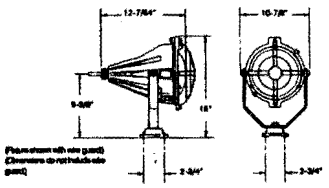
5-00-384

Xenon and Jelly Jar Lights

California Coastal Commission

PHOENIX® AMS SERIES

ALL-WEATHER ARCHITECTURAL ACCENT LIGHT



c UL us LISTED

DESCRIPTION: *The **AMS Series** is an all-weather architectural accent light. Built marine-tough, the **AMS Series** is an excellent choice for landscape lighting requiring all weather durability in harsh environments. Integral ballast and easy-open door simplify installation. Special effects can be achieved with the use of snoots, color filters and glare guards.*

SPECIFICATIONS

- **HOUSING:** Copper-free, marine-grade cast aluminum housing, base and door. Resists corrosion for longer service life.
- **FINISH:** Thermoset, powder-coated finish standard in Phoenix Green. Other color options available.
- **LENS:** Heat-resistant, heavy-duty tempered glass withstands heat and temperature shock.
- **HARDWARE:** All external hardware is stainless steel to prevent corrosion.
- **BALLAST:** HID fixtures up to 70 watts are integrally ballasted for ease of installation. Higher wattages are available with a remote ballast (supplied by others).
- **SWITCH:** Socket cut-off micro-switch supplied on double-ended units for safety during relamping.
- **EPDM GASKET:** High temperature gasket provides a positive seal against dirt and moisture.

OPTIONS

- Finish available in Black, Bronze or Gray. Other colors available upon request.
- Electronic Ballast (ELB) for use with double-ended ceramic arc tube and single-ended ED-17 type lamps.
- Electronic Ballast (ELB2) for use with double-ended quartz arc tube lamps.
- Tamper-Resistant Latches (TRL)

MOUNTING

Fasten fixture with four 3/8" bolts through holes provided in mounting base. The base can be ground (on concrete base), pendant or cantilever mounted.

ORDERING INFORMATION

	SERIES	WATT/TYPE	/	OPTICS	- OPTIONS - VOLTAGE (120V Standard)	- ELECTRICAL/ SECURITY	- FINISH (Phoenix Green Standard)
example:	AMS	70MH	/	FL	—	— TRL	—
	AMS	50MH 70MH 70MH/DE 100HID* 150HID* 150HID/DE* 50HPS 70HPS 38INC 56INC R40INC		FL SP	277V 347V	ELB ELB2 TRL	BLK BRZ GRY

WATTAGE/TYPE
MH = Metal Halide (ED-17)
MH/DE = Metal Halide (Double-Ended HID)
HPS = High Pressure Sodium (ED-17)
HID* = Single-Ended (ED-17) - MH/HPS to match ballast
HID/DE* = Double-Ended (BT37 Type) - MH/HPS to match ballast
38INC = Incandescent (PAR38; 250W max.)
56INC = Incandescent (PAR 56; 300W max., 6vd Prong)
R40INC = Incandescent (R-40; 500W max.,Mogul Base)
*Remote ballast required - supplied by others.

OPTICS
FL = Flood
SP = Spot

VOLTAGE (120V Standard)
277V = 277 Volt
347V = 347 Volt (not on 38W units)

ELECTRICAL/SECURITY
ELB = Electronic Ballast (for use with double-ended ceramic arc tube and single-ended ED-17 type lamps)
ELB2 = Electronic Ballast (for use with double-ended quartz arc tube lamps)
TRL = Tamper-Resistant Latches

FINISH (Phoenix Green Standard)
BLK = Black Finish
BRZ = Bronze Finish
GRY = Gray Finish

ACCESSORIES - SEE BACK PAGE

PHOENIX® 6161 North 64th Street • Milwaukee, WI 53218-1543 USA •Phone: 414. 431. 2300 Fax: 414. 438. 0213

LIGHTING DESIGN ALLIANCE

SEE FIXTURE SCHEDULE FOR MODEL NUMBERS AND LAMP INFORMATION

FIXTURE SPECIFICATION

ELECTRICAL ENGINEER AND CONTRACTOR RESPONSIBLE FOR FINAL VOLTAGE AND CEILING COMPATABILITY. UL LABEL REQUIRED.

TYPE F2

1234 EAST BURNETT STREET • LONG BEACH • CALIFORNIA 90806-3510 • USA • PHONE 562 989 3843 • FAX 562 989 3847

EXHIBIT NO. 5
APPLICATION NO. 5-00-384
Floodlight at Midway
California Coastal Commission

ACCESSORIES

Snoots:

Snoot Kit
7" dia., x 12" long
Order: STK-7

Solid Snoot Kit
7" dia., x 8" long
Order: STK-S7

Vented Snoot Kit
7" dia., x 8" long
Order: STK-V7

Perforated Snoot Kit
7" dia., x 8" long
Order: STK-P7

Visor:

Flat Top Visor
8.5" dia. x 8" long
Order: V-F6

For Snoots and Visors:
Phoenix Green is the Standard color. For alternate colors, add color code to the end of order number
Example: STK-P7-BLK

Snoots Accessories:

Louver Glare Guard
Black
Order: GG-EGG7

Dichroic Filter
Order:
Blue = DF-B7 **Red = DF-R7**
Green = DF-G7 **Yellow = DF-Y7**
Other dichroics available upon request

Accessories (n/a with Snoots or Visor):

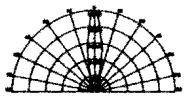
Wire Lens Guard
Order: WG-6

PHOTOMETRICS

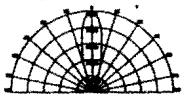
CANDELA CURVE DATA

FOOTCANDLES = CENTERLINE CANDELAS (DISTANCE FROM FIXTURE)

AMS70MH/FL
70W ED17 MH, Flood Optics
NEMA Type 4x4
5,000 Lumens



AMS70MH/SP
70W ED17 MH, Spot Optics
NEMA Type 3x3
5,000 Lumens



AMS70MH/DE/FL
70W double-ended MH, Flood Optics
NEMA Type 4x5
6,000 Lumens

AMS70MH/DE/SP
70W double-ended MH, Spot Optics
NEMA Type 4x4
6,000 Lumens

LAMPING DATA

DESCRIPTION	WATTS	LAMP TYPE	PART #
Metal Halide	50	ED-17	4220001
	70		4220031
	100		4220039
	150		Contact Factory
	70	Double Ended	4220012
	150		4220030
High Pressure Sodium	50	ED-17	4211300
	70		4212600
	100		4212700
	150		4212800
Incandescent	90	PAR38/SP	4220043
	90	PAR38/FL	Contact Factory
	150	PAR38/SP	Contact Factory
	150	PAR38/FL	4220051
	250	PAR38/SP	4220044
	250	PAR38/FL	4202700
	500	PAR56/MFL	4202400
	500	PAR56/WFL	4202500
	500	PAR56/NSP	4202600
	500	R-40/FL-125V	4201200
	500	R-40/FL-250V	4203800

COMPLIANCES

c UL us LISTED

UL Listed
1572 - Suitable for Wet Location
- Suitable for Mounting within 4 feet of the ground.
595 - Marine Type
Electric Fixture
Outside Type (Saltwater)

cUL Listed
Indoor/Outdoor Use Type 4X

US Coast Guard Accepted

N56101518

PHOENIX® 6161 North 64th Street • Milwaukee, WI 53218-1543 USA • Phone: 414. 431. 2300 Fax: 414. 438. 0213

LIGHTING DESIGN ALLIANCE

SEE FIXTURE SCHEDULE FOR MODEL NUMBERS AND LAMP INFORMATION

FIXTURE SPECIFICATION

ELECTRICAL ENGINEER AND CONTRACTOR RESPONSIBLE FOR FINAL VOLTAGE AND CEILING COMPATABILITY. UL LABEL REQUIRED.

TYPE **F2**

1234 EAST BURNETT STREET • LONG BEACH • CALIFORNIA 90806-3510 • USA • PHONE 562 989 3843 • FAX 562 989 3847

EXHIBIT NO.
APPLICATION NO.
5-00-384
Light Shield
California Coastal Co

ACCESSORIES

Common to EFX and EFI Series except where noted.

TOP SHIELD
19" Housing (SK-10-EFX-TBK)
13" Housing (SK-40-EFX-TBK)
Fixed cutoff shield for top of fixture. Standard finish is textured black. Shield can also be mounted on bottom or side of the fixture.

POLYCARBONATE LENS
19" Housing (AL-10-EFX)
13" Housing (AL-40-EFX)
The auxiliary polycarbonate lens is formed to follow the contours of the casting.

BARN DOORS
19" Housing (EFX-BD-10-TBK)
13" Housing (EFX-BD-40-TBK)
Field adjustable shields on all four sides of optical opening. Standard finish is black.

COLORED LENS
(consult factory)
Color coated polycarbonate lens available in a wide selection of colors and shades. Colors will fade over time depending on the color selection.

INTERNAL LOUVER
19" Housing (IGL-10-EFX)
13" Housing (IGL-40-EFX)
Field adjustable internal grid louver to shield the arc tube from view (112° horizontally and 122° vertical max.) Standard finish is black. Not available with EFI floodlights.

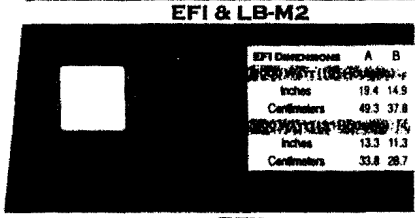
WIREGUARD
19" Housing (WG-10-EFX)
13" Housing (WG-40-EFX)
Polished stainless steel wireguard.

EFFECTIVE PROJECTED AREA

EFX EPA SQ. FT. VALUES BALLASTED MODELS	
Vertical Mount	**Horizontal Mount**
1000–750 Watt - 5.1	1000–750 Watt - 3.3
400–70 Watt - 2.7	400–70 Watt - 1.8
EFI EPA SQ. FT. VALUES	
1000–750 Watt - 3.5	
400–70 Watt - 1.8	

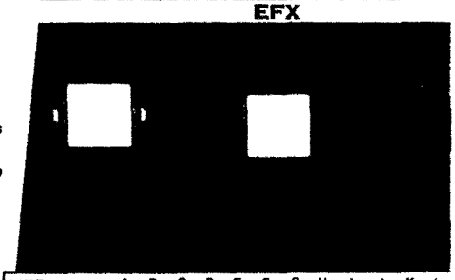
DIMENSIONS

EFI & LB-M2



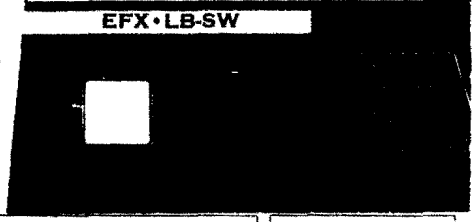
EFI Dimensions	A	B
[illegible]		
Inches	19.4	14.9
Centimeters	49.3	37.8
[illegible]		
Inches	13.3	11.3
Centimeters	33.8	28.7

EFX



EFX Dimensions	A	B	C	D	E	F	G	H	I	J	K	L
[illegible]												
Inches	19.4	20.9	22.5	8.2	12.7	29.2	14.9	7.9	14.1	24.4	14.0	21.9
Centimeters	49.3	53.1	57.2	20.8	32.3	74.2	37.8	20.1	35.8	62.0	35.6	55.6
[illegible] (13" Housing)												
Inches	13.3	16.8	16.2	7.0	9.8	22.2	11.3	6.3	11.3	19.1	10.7	16.1
Centimeters	33.8	42.7	41.2	17.8	24.9	56.4	28.7	16.0	28.7	48.5	27.2	40.9

EFX • LB-SW



LIGHTING DESIGN ALLIANCE

SEE FIXTURE SCHEDULE FOR MODEL NUMBERS AND LAMP INFORMATION

FIXTURE SPECIFICATION

ELECTRICAL ENGINEER AND CONTRACTOR RESPONSIBLE FOR FINAL VOLTAGE AND CEILING COMPATABILITY. UL LABEL REQUIRED

TYPE

F3

1234 EAST BURNETT STREET • LONG BEACH • CALIFORNIA 90806-3510 • USA • PHONE 562 989 3843 • FAX 562 989 3847

EXHIBIT NO. 7
APPLICATION NO. 5-00-384
Floodlights near base
California Coastal Commission

WATERTIGHT H.I.D. HAZARDOUS LOCATIONS LIGHTING FIXTURE

PAULUHN

CAST BRONZE OR COPPER - FREE ALUMINUM

MERCURY VAPOR, METAL HALIDE HIGH PRESSURE SODIUM TEMPERATURE CODE T2

U.S.C.G., U.L. 595, 844, NEMA 4X AND 5
CLASS I, DIVISION 2, GROUP A, B,C & D
CLASS I, ZONE 2,GROUPS IIA, IIB, IIB +H2 AND IIC

C S A
A B S
I P 5 6

TECHNICAL DATA

OUTLETS: Bulkhead mounted units are furnished blank. Ceiling mounted units are furnished with four 1/2" N.P.T. holes and three plugs. Pendant mounted units are furnished with one 3/4" N.P.T. Stanchion mounted units are furnished with one 1 1/4" N.P.T. outlet.

OPTIONS

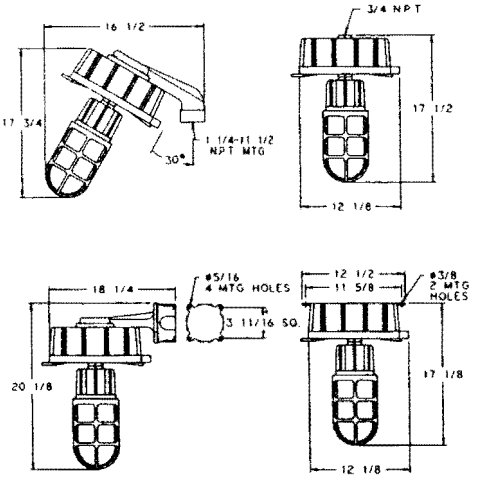
FINISH: Special coatings are available on request.

REFLECTORS: For a white impact resisting ABS shallow dome reflector add the suffix "L". For a white impact resisting ABS 30° angle type reflector add the suffix "N". (Bulkhead mounted fixture accepts 30° angle reflector only.)

BALLAST: A 480 VAC 60 HZ ballast is available as an option with the suffix "-486". 50 HZ ballasts are available in some wattage-voltage combinations on special application.

OUTLETS: All units, except stanchion units, can be provided drilled and tapped with maximum 1 1/2" N.P.T. holes on application.

GLOBE: A fluted, prismatic, globe is available on application.



SPARE PARTS

Lamp-

Mercury Vapor	100W	INX3538
	175W	INX3553
High Pressure Sodium	70W	INX3568
	100W	INX3547
	150W	INX3540
Metal Halide	175W	INX3551

Globe-INX2008HR

Guard-INX1038 A or B SCR

Gasket-
GKT3006 Box
GKT2033 Globe

Lampholder INX4004 - Mercury, Metal Halide
- High Pressure Sodium

Reflector - INX4545 A or B - Shallow Dome
INX4541 A or B - 30° Angle

BALLASTS

Voltage	Mercury Vapor		High Pressure Sodium			Metal Halide
	100W	175W	70 W	100 W	150 W	175W
MULTI-TAP	INX5013	INX5012	INX5087	INX5014	INX5015	INX5022
480 VAC	INX5075	INX5018	INX5088	INX5056	INX5058	INX5072

PAULUHN ELECTRIC MANUFACTURING COMPANY, INC.

P O Box 53 Pearland Texas 77588-0053 (7 1 3) 485-4311 Fax (713) 485-4396

HL9

LIGHTING DESIGN ALLIANCE

SEE FIXTURE SCHEDULE FOR MODEL NUMBERS AND LAMP INFORMATION

FIXTURE SPECIFICATION

ELECTRICAL ENGINEER AND CONTRACTOR RESPONSIBLE FOR FINAL VOLTAGE AND CEILING COMPATABILITY. UL LABEL REQUIRED.

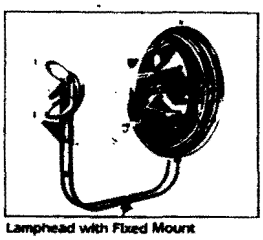
TYPE F4

1234 EAST BURNETT STREET • LONG BEACH • CALIFORNIA 90806-3510 • USA • PHONE 562 989 3843 • FAX 562 989 3847

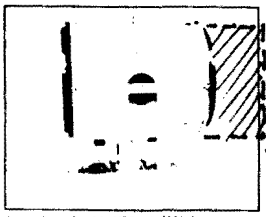
EXHIBIT NO. 8
APPLICATION NO. 5-00-384
Jelly Jar Lights

California Coastal Commission

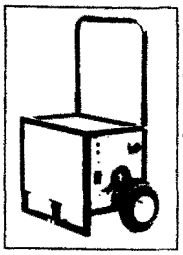
XELAMP XENON SEARCHLIGHT



Lamphead with Fixed Mount



Lamphead with "Movie" Yoke



Rolling Cart Power Supply

MANUFRTR TO PROVIDE 360° SHIELDING

The Model 6800 Lamphead makes up a family of searchlights in the 2,000 to 7,000 watt range using short-arc xenon lamps to produce an intense, pencil beam of white light. These lampheads, with appropriate power supplies and cables, comprise a complete system.

The lamphead reflector (paraboloid) collects the light and transmits it foward through the safety glass. The beam diameter is optimized at 20 inches, but can be adjusted to about 60 inches before the center starts to loose intensity. Adustments are available to the shape (circularity) and uniformity of the beam. Beam divergence is in the order of 2° to 4°.

The lamphead is capable of operating from -10 degrees (down) to +90 degrees (vertical up).

The 6800 lamphead is approximately 27" x 27" x 33" long. Several mounting options are available for fixed and mobile applications.

SPECIFICATIONS:

	2 KW	4 KW	7 KW
POWER SUPPLY MODEL	8502	8506	8537
INPUT POWER	208/240	208/240	208/240
		380/440	380/440
INPUT PHASE	1	3	3
/LAMP VOLTAGE INPUT	24 ± 3	32 ± 3	46 ± 3
LAMP CURRENT INPUT	55-80	90-145	140-180
PEAK BEAM CANDLEPOWER (millions)	195	325	600

Power supply configurations are available for fixed and mobile applications.

Available from:

L.P. ASSOCIATES, INC.
6650 Lexington Avenue
Hollywood, CA 90038
TEL: 213-462-7750 FAX 213-462-7584

LIGHTING DESIGN ALLIANCE

SEE FIXTURE SCHEDULE FOR MODEL NUMBERS AND LAMP INFORMATION

FIXTURE SPECIFICATION

ELECTRICAL ENGINEER AND CONTRACTOR RESPONSIBLE FOR FINAL VOLTAGE AND CEILING COMPATABILITY. UL LABEL REQUIRED.

TYPE

F6

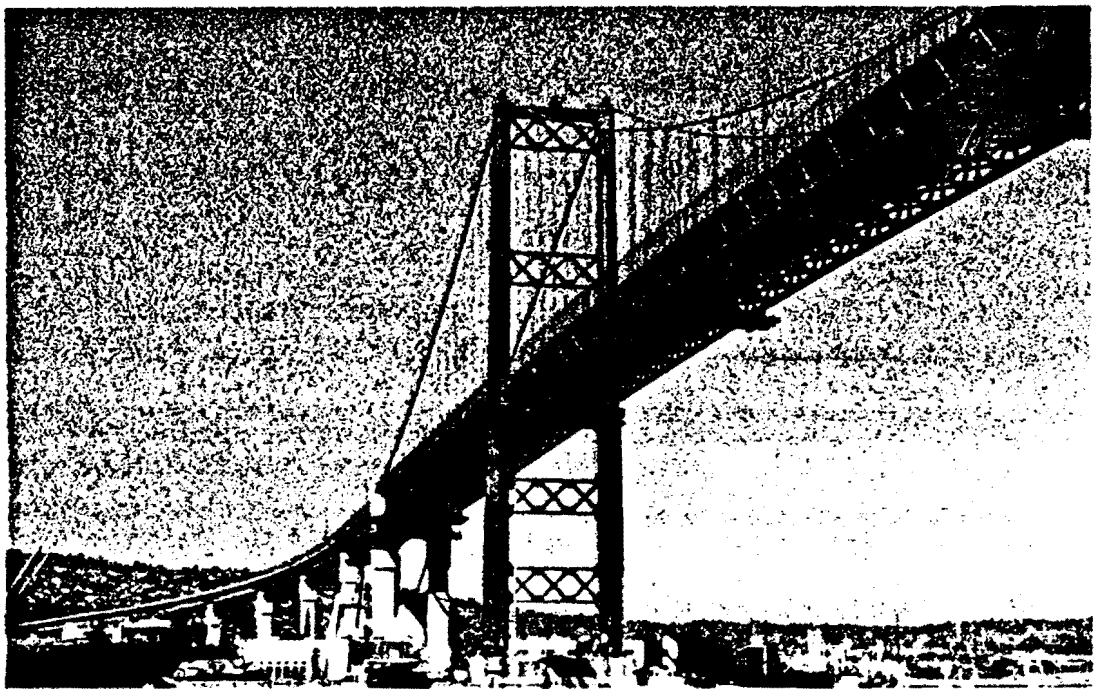
1234 EAST BURNETT STREET • LONG BEACH • CALIFORNIA 90806-3510 • USA • PHONE 562 989 3843 • FAX 562 989 3847

EXHIBIT NO. 9
APPLICATION NO. 5-00-384
Xenon lights
California Coastal Commission

Technical Report

to Assess the potential impacts of the

Vincent Thomas Bridge Lighting Project



Prepared by:

California Department of Transportation
District 7 - Office of Environmental Planning
120 S. Spring St.
Los Angeles, CA 90012

Introduction

Approximately 12 years ago, the Vincent Thomas Bridge Lighting Committee was formed by a group of San Pedro residents to promote the placement of decorative lighting on the bridge. As a major landmark in the Los Angeles Harbor area, the intent was to transform the bridge into a grand entrance to Los Angeles for people arriving via the Harbor.

The project has been endorsed by the City of Los Angeles, with the Cultural Affairs Department serving as its primary advocate. And, the California Department of Transportation (Caltrans), as the owner and operator of the bridge, has signed a Memorandum of Understanding with the City agreeing to the placement of the lights on the bridge. Although the project has progressed at varying rates of speed over the past 12 years, the approaching turn of the century has provided renewed interest in seeing it move to completion in time for a millenium celebration on December 31, 1999.

This Technical Report has been prepared as part of the environmental documentation required for clearance under the California Environmental Quality Act (CEQA). Its goal is to address the potential environmental impacts of the project, assess the significance of those impacts and identify alternatives for avoiding, minimizing or mitigating those impacts.

Project Description

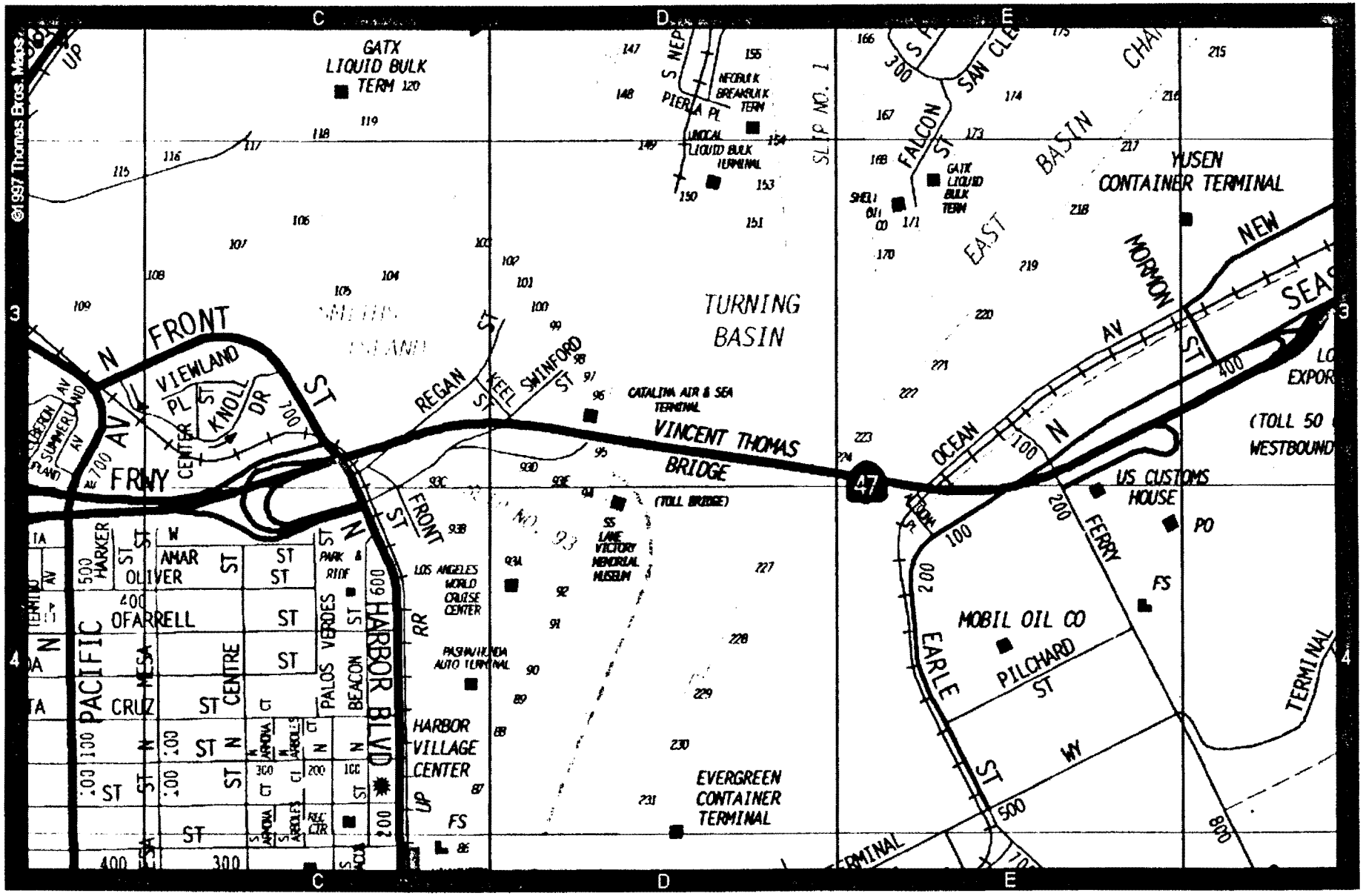
This project involves the installation of lighting on the two bridge towers, which are located on either side of the Los Angeles Main Channel. These towers extend to a height of 335 feet above ground level (335 feet above sea level). The lighting will consist of banks of lights at the base and mid-tower levels that will result in the illumination of the entire length of each tower. In addition, two 7000-watt xenon lights will be located at the top of each tower; these will be stationary, sending vertical beams of light directly overhead to form a visual continuation of the bridge towers into the night sky. Also at the top of each tower will be a sculptural element containing four 8 foot-diameter parabolic discs designed to reflect the light of the sun during the day and artificial light at night.

The initial lighting ceremony is scheduled to occur at 9:00 PM on December 31, 1999 in conjunction with the City of Los Angeles' millenium celebration. This is a permanent installation, with the lights intended to be on nightly after that from approximately sunset to sunrise.

Environmental Setting

The Vincent Thomas Bridge is located in the southern part of Los Angeles and connects the community of San Pedro with Terminal Island in the Port of Los Angeles (PoLA). As shown on the area map, the bridge runs in an east-west direction and spans the Los Angeles Main Channel. The Port of Long Beach is located to the east of, and adjacent to, the PoLA. The area immediately surrounding the bridge is primarily industrial, with cruise ship docks, cargo loading and storage areas and other facilities associated with

Vicinity Map for Vincent Thomas Bridge



operating the West Coast's busiest port. The nearest residential areas of San Pedro are located approximately ½ mile to the southwest.

The industrial nature of the PoLA has resulted in the presence of a highly disturbed and artificial landscape. There is no native vegetation in the vicinity of the bridge.

There are numerous lights throughout the combined Ports of Los Angeles and Long Beach. Many of these lights, which are located in parking and cargo lots, on/in buildings and on cranes and other equipment/facilities, are left on throughout the night. The weather conditions within the Ports often have the effect of magnifying this light. The late night and early morning low clouds and fog that are typical of coastal southern California often result in a yellowish glow throughout much of the land portion of the ports.

This area is located along the Pacific Flyway, the coastal migratory path used by many shorebirds. Seal Beach, a major stopover point for between 100,000 and 1,000,000 birds each spring, is about 20 miles to the south. The harbor area is also along the broad-band migratory path of many neotropical songbirds.

Sensitive Resources

Several sensitive resources have been identified as being potentially affected by this project. These are described below:

Peregrine Falcons

The Vincent Thomas Bridge has been the year-round home for a pair of American peregrine falcons (*Falco peregrinus*) for the past several years. Although their nesting/roosting locations vary from year to year, they can frequently be found on the steel-girder structure below the roadway between the two towers.

This species was recently removed from the federal endangered species list; however, it is still listed as endangered at the state level. The state Endangered Species Act protects listed species from being killed or harmed. However, personnel from the Department of Fish and Game have indicated that the definition of harm includes only physically harming the birds or removing their nest. Neither of these will occur as a result of this project.

The peregrine is also still protected under the federal Migratory Bird Treaty Act (it is considered a migratory species, despite being a year-round resident at this location), meaning that it is illegal to harm, harass or kill individuals of this species. In this case, harassment could occur if the nighttime illumination of the bridge sufficiently disturbed the birds to cause them to leave the bridge. This could be especially dangerous because peregrines do not have good night vision; forcing them to fly at night could result in collisions with other objects, causing injury or death.

A related concern is that any disturbance to the peregrines might result in increased predation on the California least tern (*Sterna antillarum brownii*) (state and federal endangered) and western snowy plover (*Charadrius alexandrinus nivosus*) (federal threatened, state species of concern). Both of these species have breeding colonies nearby on Terminal Island. Any harm to them would be in violation of the Endangered Species Acts.

To address these concerns, the project was discussed with Carl Thelander, a peregrine expert and consultant/monitor for the Vincent Thomas Bridge seismic retrofit project. Based on the project description and his familiarity with peregrines in general, and the resident birds in particular, it is his belief that the project will not pose a problem for the birds.

One additional concern is the potential conflict that might arise between the peregrines and barn owls and great horned owls that live in the harbor area. It is possible that the lights might have the effect of extending the daylight hours in the vicinity of the bridge. If this results in the peregrines being active after the nocturnal owls have begun to hunt, a conflict between these species might arise. Although this is probably a minor problem, it might still be advisable to ensure that the lights are turned on no sooner than 30 minutes after sunset and turned off no later than 30 minutes before sunrise to ensure that potential conflicts between these species are avoided.

Migratory Birds

Bird Migration:

Coastal southern California is along the migratory path of numerous species of birds. Both shorebirds and neotropical songbirds either come to this area to breed or pass through here on their way to other locations. While the majority of shorebirds migrate during the day, there are some that fly at night. Most songbirds are nocturnal migrants. Although the broadband migration of songbirds doesn't concentrate these birds along the immediate coast, there are still many species and many individuals that do move through this area.

Migration occurs mostly in a south to north direction during the spring as birds move from their winter homes in the more tropical latitudes toward their breeding grounds. In the fall, this direction is reversed as the birds return to their wintering grounds. The peak periods for migration through southern California are March through May and August through October.

The elevation at which birds migrate varies enormously and depends on such factors as the species, location, geographic features, season, time of day and weather conditions. However, as a group, songbirds tend to fly at relatively low levels.

It appears that there have been no studies from coastal southern California from which we can extrapolate much detailed information about the nocturnal migrants that fly over the harbor area. Although the presence of certain species is either known or can be assumed,

a detailed species list as well as an estimate of the numbers of individuals for each species is lacking. A list of species that might pass through the harbor area is shown below and is based on information gathered from the Pt. Reyes Bird Observatory.

Common Name	Scientific Name	Protected Status	Comments
Bell's vireo	*Vireo bellii*	-	
Warbling vireo	*Vireo gilvus*	-	Is being considered for CSC
Southwestern willow flycatcher	*Empidonax traillii extimus*	FE	
Olive-sided flycatcher	*Contopus borealis*	MNBMC	
Brewer's sparrow	*Spizella breweri*	-	
Bell's sage sparrow	*Amphispiza belli belli*	FSC, CSC, MNBMC	
Yellow warbler	*Dendroica petechia brewsteri*	CSC	
Black-headed grossbeak	*Pheucticus melanocephalus*	-	
Common yellowthroat	*Geothlypis trichas*	-	
Townsend's warbler	*Dendroica townsendi*	-	
Hermit warbler	*Dendroica occidentalis*	MNBMC	
Lewis' woodpecker	*Melanerpes lewis*	-	
Band-tailed pigeon	*Columba fasciata*	-	
Eastern wood pewee	*Contopus virens*	-	Migrate in large numbers
Western flycatcher	*Empidonax difficilis*	-	Migrate in large numbers
Swainson's thrush	*Catharus ustulatus*	-	
Wilson's warbler	*Wilsonia pusilla*	-	Fall migration is primary concern
Yellow-breasted chat	*Icteria virens*	CSC	
Blue grossbeak	*Guiraca caerulea*	-	
Grasshopper sparrow	*Ammodramus savannarum*	MNBMC	
Western meadowlark	*Sturnella neglecta*	-	
White-crowned sparrow	*Zonotrichia leucophrys*	-	Migrate in large numbers. Susceptible to light

FE - Federal endangered
FSC - Federal Species of Concern
CSC - California Species of Concern
MNBMC - Migratory Non-game Bird of Management Concern

This list contains several species that have state or federal protected status. It is by no means complete, and there is a high probability that additional sensitive species pass through the area.

The Problem:
There have been many studies and reports that indicate that lights on tall structures can pose a problem for night migrating birds (Manville, 1999). Although the earliest reports dating back to the 1880s involved lighthouses, more recent reports (since the late 1940s) have been associated with tall (over 200 feet) communications towers. These so-called tower kills, in which large numbers of migrating birds are killed in a single incident, have also been known to involve lighted monuments (e.g., the Washington Monument), smoke stacks and airport ceilometers. Most of the reports from the United States come from the eastern and central part of the country. Although there is not much documentation of problems associated with lighted bridges, this could be because most birds hitting a bridge would fall into the water or be removed by scavengers and would therefore not be noticed (Measure, pers. Com.).

Of the birds reportedly killed by lit towers, the 350 species of neotropical migratory songbirds, and in particular thrushes, vireos and warblers, seem to be most vulnerable (Manville, 1999). They are especially susceptible when foggy, misty or low-cloud-ceiling nights occur during their migrations.

The exact mechanism behind the attraction of birds to lighted structures is still unclear (WWFC, 1996). Studies tend to support the theory, however, that migrant birds are not attracted to the lights from a distance. Instead it is believed that those birds passing by on cloudy nights enter an illuminated area that they are reluctant to leave; when the birds approach the edge of the illuminated area, they are hesitant to fly into the darkness beyond and instead fly back toward the light. This sets up a pattern of birds circling around the lit area. As more birds enter this limited space, the likelihood of collisions between birds or between birds and other obstructions increases. Those birds that aren't killed in collisions frequently fly around in circles until they become exhausted and simply fall from the sky.

One indication of the magnitude of the problem comes from a recent (January 22, 1998) event in western Kansas in which an estimated 10,000 Lapland Longspurs were killed at, and in the vicinity of, three towers and a natural gas pumping facility (Manville, 1999). Many other incidents involving up to, and in some cases more than, 1000 birds are noted in an annotated bibliography prepared by the U.S. Fish and Wildlife Service's (the Service) Office of Migratory Bird Management (Trapp, 1998). In 1979, the Service estimated an annual mortality at around 1.4 million birds (Manville, 1999). Today's conservative estimate is upwards of 4 million birds killed per year.

This Project:
In order to assess whether or not this project will present a potential problem to migratory birds, the existing conditions were documented, similar local and distant projects were reviewed, and the project was discussed with experts familiar with this issue.

As mentioned previously, the harbor area where the bridge is located is fairly well lit at night. Low clouds and fog frequently move into the area at night, resulting in a yellowish

glow above the harbor. One would have to wonder if the lights proposed for this bridge would really stand out enough to attract birds as they pass by. On the other hand, it could be the nights without low clouds and fog that would pose greater concern; it may be those times when the lights would stand out the most. Without conducting a test with the lights in place, it is difficult to know which situation, if any, would pose a significant threat to birds flying by.

One thing that is known is that there currently is a flashing red navigational light on the top of each bridge tower. Birds are thought to be less sensitive to flashing red lights than to other forms of light. Also, the maintenance crew at the bridge have not reported finding any dead birds near the bridge. However, it is possible that any existing problem would go unnoticed because the birds could fall in the water or be removed by scavengers.

A situation similar to what is being proposed, in which high intensity lights are directed into the sky, can be found nearby. The Landmark Square Building is located in Long Beach approximately 3 miles away from the Vincent Thomas Bridge and just a few blocks from the ocean. It has 4 (four) 3000 watt xenon lights pointing straight up from the roof. These lights, which have been in operation since 1991, are on year-round for four nights per week between sunset and midnight. According to Sam de Lemos, the building's chief engineer, these lights are inspected weekly and there has been no indication that birds have been killed. This is the best, and certainly the closest, example of a lighting situation that is similar to what is being proposed. And, it is promising that no problems have been reported. However, it does not demonstrate conclusively that this project will not cause a problem because the majority of tower kills (bird deaths) occur between 11pm and sunrise (Mesure, 1999).

Another building with a high intensity light (the Sky Beam) on top is the Luxor Hotel in Las Vegas. According to John Listiner, who is in charge of the Technical Division which oversees the Sky Beam, they have not reported any bird kills since the hotel opened in 1993. However, the Las Vegas area seldom has the low cloud cover conditions that are common during bird kill events.

There is very little information available concerning lights on bridges. One project that was noted, however, involved a proposal to install floodlighting on the Humber Bridge in northeastern England. This bridge runs across major east-west and north-south migration routes and is a Ramsar site and Special Protection Area. The sensitive nature of this bridge's location led to the abandonment of the project earlier this year. While it is important to point out that the Los Angeles Harbor is not as environmentally significant as a Ramsar site, it should be noted that this issue is considered important by the world environmental community.

Finally, this project was discussed with several experts familiar with the issue of lights and birds. Many of these people were invited speakers at a session entitled "Avian

Mortality at Communications Towers" held at this year's 117th Meeting of the American Ornithologists' Union. Their key comments are shown below:

Kimball Garrett, ornithologist with the Los Angeles Natural History Museum
- lights are mainly a problem when they're surrounded by darkness.
- since the Harbor is so well lit, he didn't feel that the lights were likely to cause a major problem.
- most songbirds don't move along the coast, but there will still be many individuals of many different species that do.

Robert Beason, biology professor at the State University of New York in Geneseo
- floodlighting is the major concern, especially during times of low cloud cover.

Michael Mesure, founding member of the Fatal Light Awareness Program (FLAP)
- the lighting on the bridge will be comparable to the communications towers that have been studied.
- the spot lights directed into the air are the worst part of the project.
- he suggested that we try to accomplish the intended effect without using lights or by modifying the lights (using strobe lights or less intense lights).
- if lights must be used, pointing them down from the top would be less harmful to migratory birds.
- birds "caught" by the lights may send out distress calls that attract more birds.
- shorebirds can also be attracted by the lights.
- there is not a lot of documentation concerning lights on bridges, possibly because most birds fall into the water or are taken by scavengers.
- the majority of collisions occur between 11:00pm and sunrise.
- one night with the right conditions could result in a significant bird kill.

Ronald Larkin, Illinois Natural History Survey
- the severity of the problem will depend on the number of days that low clouds and fog are present during the migration season and on the number of birds that migrate along the coast.
- the bridge is high enough to pose a problem.
- the lights shining straight up are "such a bad idea."

Jeff Geupal, Program director for terrestrial birds at Pt. Reyes Bird Observatory and state coordinator for Partners-in-Flight
- provided a list of species that might be impacted.
- indicated concern about bird species declining statewide and thought that this project could inhibit their recovery.
- felt that the fall migration is more critical because juveniles suffer higher tower kill mortality than adults and that could jeopardize the population recovery for species of concern.

Sidney Gauthreaux, Jr., biology professor at Clemson University
- indicated that some birds fly in vertical circles and actually fly into the lights.
- stated that the project would be creating hazardous conditions for migratory birds.

Albert Manville, Director of the U.S. Fish and Wildlife Service's Office of Migratory Bird Management
- birds are more sensitive to the red end of the color spectrum.
- white strobe lights with a long dark period might have the least negative effect.
- we need to consider potential impacts to listed species, species covered by the Migratory Bird Treaty Act, non-game species of management concern and other migratory species.
- he stated that "incidental take" permits are not issued for migratory birds and that the project proponents could be legally liable in the event of a large bird kill. Liability would also be encountered if a listed threatened or endangered species is killed.
- he stated that a large bird kill would result very bad publicity.
- he suggested that further study of the issue might be warranted if the impacts are unknown. A better indication of what species and how many individuals migrate through the area can be obtained using radar imagery, acoustic chirp calls, night vision equipment and ground truthing.
- he also suggested that perhaps the lights should be turned off during the migrating season.

In summary, all but one person contacted expressed serious concern about the project and its potential effect on migratory birds. Most people also indicated that the Skytracker lights at the top of each tower presented the most serious potential for harm.

Fish

Concerns have been raised about the possibility that the increase in nighttime lighting will be detrimental to fish in the channel. In particular, it is feared that certain mid-water column dwelling fish, such as various species of basses (calico bass, spotted sand bass) might be attracted to the water's surface by the light. Once there, they might be susceptible to predation by sea lions, night herons, gulls or other predators.

This issue was raised at a time when the project included additional lighting that would have illuminated a large portion of the underside of the bridge over the channel. Although all lights were (and still are) to be directed away from the water, and though some areas of the water's surface are already lit by numerous existing lights, it was thought that these additional lights might have added sufficient illumination to the water to cause a problem.

It is believed that the current lighting plan, which only includes lighting the towers, will not result in a significant lighting of the water beyond the existing conditions. It will therefore probably have only a minimal impact, if any, on fish in the channel. However, without knowing how deep the light will penetrate the water column, it is not possible to conclude that there will be no impact.

Other Issues

Light Pollution

Another issue that has been raised by some people familiar with this project is that of light pollution. Michael Mesure of F.L.A.P. and Robert Gent of the International Dark-Sky Association have pointed out that these lights will add to this growing problem and that it will reduce our ability to enjoy the night sky. Because the light from the floodlights is more diffuse, they represent a greater light pollution problem than do the tightly focused Skytracker lights. Mr. Gent suggested that the flood lights be directed down from the top of the towers or that they be replaced with lower intensity Christmas-type tracer lights along the bridge structure.

To address this concern, it is important to remember what the ambient conditions in the harbor are. It is already a very well lit area. While the additional lights from this project may have an effect on the viewing quality of the night sky, the degree of impact is probably minimal. It is also likely that any noticeable impact would only be visible from the immediately surrounding area.

Energy Consumption

The additional energy required to run these lights has also been raised as an issue. According to Ron Merlo, Director of Corporate Assets for the City of Los Angeles' Department of Water and Power (DWP), the project is anticipated to use approximately 30 million KWHr/Yr (or about 82,192 KWHr/day). This compares to DWP's total sale of 23 billion KWHr/Yr (or 63 million KWHr/day). So, it is clear that the energy used by this project will amount to a small fraction of the total output from DWP. In addition, this energy will be utilized during off-peak hours. This project will therefore not require an expansion of DWPs energy generating capacity.

Potential Mitigation Measures to Avoid or Minimize Impacts

The following options have been developed and considered in order to avoid or minimize potential
impacts. These measures, singly or in combination, will allow the project to move forward and meet its goal of having the lights operational by December 31, 1999:

1. Turn the lights on at least 30 minutes after sunset and off at least 30 minutes before sunrise to avoid inducing conflicts between peregrines and owls.

2. Leave the lights on year-round and monitor the surrounding area during the migrating season for evidence of bird mortality. The effectiveness of this monitoring would be hampered by the presence of water under the bridge and scavengers and by the fact that there is no way to predict how long it would take (how many years?) before any mortality occurred. If mortality is observed, the lights will be turned off and the U.S.Fish and Wildlife Service and California Department of Fish and Game will be consulted to identify an appropriate course of action.

3. Turn the lights off completely during the migrating season (March through May and August through October).

4. Turn the lights off from 11:00pm to sunrise during the migrating season (March through May and August through October). This will avoid what seems to be the most sensitive time for tower kills.

5. Conduct a detailed study to identify the number of birds and the species that migrate through the area. This could include the use of acoustic chirp calls, radar imagery, night vision scopes, and ground truthing, among other techniques. This would provide useful background information that could be used to make appropriate adjustments to the lighting schedule.

6. Use the most tightly focused beam possible and glare shields on the Skytracker lights to help minimize the spread of light and help the beam penetrate the fog and low clouds.

7. In the event that any light-related mortality of birds is observed, the lights should be turned off immediately until the California Department of Fish and Game and the U.S. Fish and Wildlife Service are notified and an appropriate course of action is identified.

Summary of Potential Impacts and Mitigation

The table below provides a summary of the key information provided in the text above. It contains a brief description of the potential impacts, an assessment of their probability of occurrence, their potential significance and information on potential mitigation measures.

Potential Impact	Probability of Occurrence	Potential Significance	Mitigation
Peregrine falcons			
Harassment by nighttime lighting could result in injury or death	Low	Low	Not needed
Harassment of peregrines could result in increased predation on CA least terns and western snowy plover	Low	Low	Not needed
Conflict between peregrines and owls	Low to Moderate	Significant, if it results in death of a peregrine or owl	Yes, #1
Migratory Birds			
Tower kill of migratory birds	Unknown	Potentially significant	Yes, #2,3, or 4 5,6, and 7
Tower kill of migratory state or federally listed threatened or endangered species	Unknown	Potentially significant	Yes, #2,3 or 4 5,6, and 7
Could inhibit the recovery of declining bird populations statewide	Unknown	Probably minor	Yes, #2,3 or 4 5,6, and 7
Fish			
Could increase the susceptibility of mid-water column dwelling fish to predation	Probably low	Probably minor	Not needed
Light Pollution			
Could increase light pollution in the immediate area	Low to moderate	Probably minor	Not needed
Energy Consumption			
Will increase energy consumption and the need for additional generating capacity	Low	Low	Not needed

Recommendations

The objective of this project is to provide lighting which will identify the Vincent Thomas Bridge as a gateway landmark for the Port and City of Los Angeles and to have this lighting operational in time for the millenium celebration scheduled for 9:00pm on December 31, 1999. This report has identified potential impacts associated with the project and potential methods to avoid or minimize those impacts while allowing the project's stated objective to be met.

Because there is insufficient information available to conclusively determine that significant impacts will not occur to migratory birds, including threatened or endangered species, the following recommendations are made. They are based on the best information that is available at this time.

1. The lights can be turned on year-round, but should be turned off between 11:00pm and sunrise during the migrating season (March through May and August through October).
2. The lights should be turned on a minimum of 30 minutes after sunset and turned off a minimum of 30 minutes before sunrise.
3. Use the most tightly focused beam possible and glare shields on the Skytracker lights to help minimize the spread of light and help the beam penetrate the fog and low clouds.
4. Additional research to identify the number of birds and the species that migrate through the harbor area should be conducted. This could include the use of acoustic chirp calls, radar imagery, night vision scopes, and ground truthing, among other techniques. This would provide useful background information that could be used to make appropriate adjustments to the lighting schedule.
5. In the event that any light-related mortality of birds is observed, the lights should be turned off immediately until the California Department of Fish and Game and the U.S. Fish and Wildlife Service are notified and an appropriate course of action is identified.

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October 9, 2000

Vincent Thomas Bridge Lighting Project
Supplemental Information

The following information has been gathered to provide additional background to help assess potential impacts of the new lighting design on migratory birds.

Bird Migration:

Migratory Flyways:

Within North America, migratory birds tend to travel in a north-south direction along four migratory flyways: Pacific, Central, Mississippi and Atlantic (Fig. 1) (Journey North, 2000). These flyways are generalizations and it is important to remember that birds frequently do not follow a straight north-south route. It is also important to note that most species of migratory songbirds utilize a broad-band migration that does not conform to any flyway.

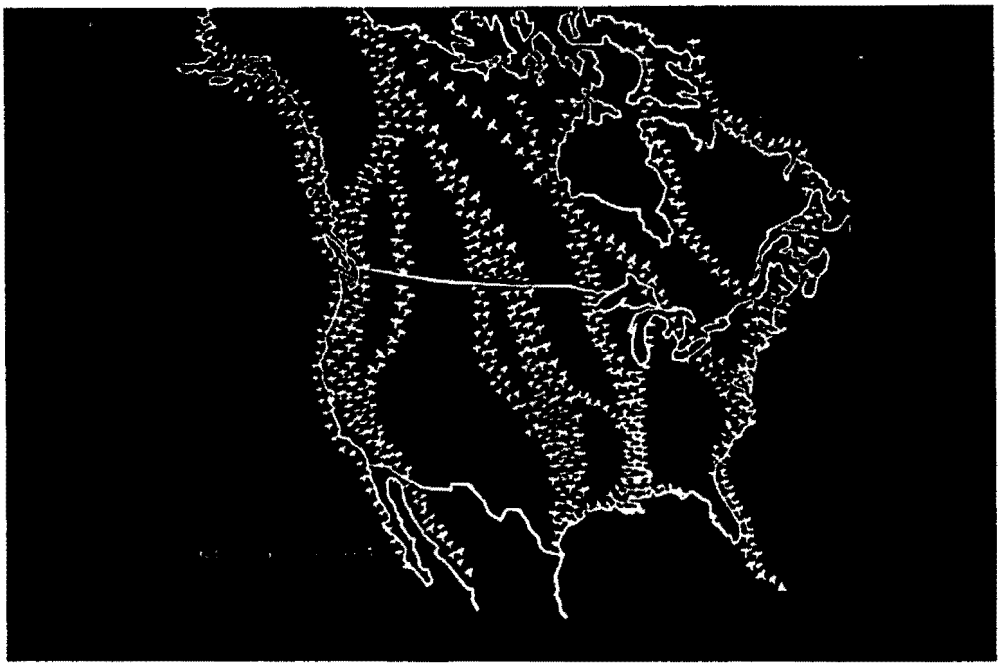

Fig. 1 Migratory bird flyways in North America

Migration Altitude:

The altitude at which migratory birds fly is determined by several factors, including wind speed and direction, air temperature, weather conditions (cloud cover) and the length of the migration (Kerlinger and Moore, 1989). A trade-off exists between flying low to avoid the strong winds present at higher altitudes (except when the wind direction is favorable) and flying high to take advantage of cooler temperatures; in general, migration tends to occur at low altitude in head winds and at high altitude in tail winds (Alerstam, 1993). Birds also tend to avoid flying in clouds; overcast conditions act to concentrate birds at lower altitudes.

There is great variability, both within and between species, in the altitude at which nocturnal migrants fly (Kerlinger and Moore, 1989). Studies have shown elevations ranging from below 300 meters (984 ft) up to 3500 meters (11,480 ft) above ground level; but, because some species are difficult to detect while flying at night, the studies probably overestimate the altitude of migration. Part of the variability is a result of individuals responding to changing weather and topography, which may cause them to climb, cruise and descend though several hundred or thousand meters (feet) in elevation during any one flight.

In the harbor area, the prevailing winds are onshore, from south to north (perpendicular to the coast). Since these winds would tend to blow birds off course during their flights up or down the coast, it seems likely that birds would tend to fly lower to avoid the stronger winds. The low clouds and fog that frequently occur in this area would also likely lead to a lower flight altitude.

Migratory Species:

A list of approximately 340 species of birds that have been seen at or near Ken Malloy Harbor Regional Park (located about 3 miles northwest of the Vincent Thomas Br.) has recently been compiled from a variety of sources (Heindel, 2000). This list was compared to a list of neotropical migrant birds (Rappole, 1995) to identify the migrant species that are likely to fly in the vicinity of the Vincent Thomas Bridge. Table 1 provides this list as well as information on their protected status, if any. Of these species, most of the passerines (song birds), a large number of the waterfowl and shorebirds, and a variety of other types of birds will be nocturnal migrants (Kerlinger and Moore, 1989).

Table 1.

NEOTROPICAL MIGRATORY BIRDS AT HARBOR REGIONAL PARK

Species	Residence Status at Harbor Park	Protected by the MBTA?	Special Status
Pied-billed Grebe	Occurrence: resident Status: breeds regularly	yes	
Eared Grebe	Occurrence: winters Status: formerly bred	yes	
Western Grebe	Occurrence: winters Status:	yes	
Clark's Grebe	Occurrence: winters Status:	yes	
American White Pelican	Occurrence: winter vagrant Status:	yes	State: CSC
Brown Pelican	Occurrence: Status:	yes	Federal: MNBMC State: FP
Double-crested Cormorant	Occurrence: may occur any season Status:	yes	State: CSC
American Bittern	Occurrence: winters, occurs rarely Status: formerly bred	yes	Federal: MNBMC
Least Bittern	Occurrence: resident Status: breeds regularly	yes	Federal: MNBMC
Great Blue Heron	Occurrence: may occur any season Status: nests nearby	yes	
Great Egret	Occurrence: may occur any season Status:	yes	
Snowy Egret	Occurrence: may occur any season Status:	yes	

Little Blue Heron	Occurrence: fall vagrant Status:	yes	
Cattle Egret	Occurrence: may occur any season Status:	yes	
Green Heron (green-backed heron)	Occurrence: resident Status: breeds regularly	yes	
Black-crowned Night-Heron	Occurrence: resident Status: breeds regularly	yes	
Yellow-crowned Night-Heron	Occurrence: no record in last 15 years Status:	yes	
White-faced Ibis	Occurrence: extirpated, fall vagrant Status:	yes	Federal: MNBMC State: CSC
Wood Stork	Occurrence: no record in last 15 years Status:	yes	State: CSC
Fulvous Whistling-Duck	Occurrence: extirpated from park Status: formerly bred	yes	State: CSC
Greater White-fronted Goose	Occurrence: occurred rarely Status:	yes	
Snow Goose	Occurrence: no record in last 15 years Status:	yes	
Wood Duck	Occurrence: winters Status:	yes	
Green-winged Teal	Occurrence: regular migrant, winters Status:	yes	
Mallard	Occurrence: regular migrant, winters Status: breeds regularly	yes	
Northern Pintail	Occurrence: regular migrant, winters Status:	yes	
Blue-winged Teal	Occurrence: may occur any season Status: breeds irregularly	yes	
Cinnamon Teal	Occurrence: resident Status: breeds regularly	yes	
Northern Shoveller	Occurrence: regular migrant, winters Status:	yes	
Gadwall	Occurrence: may occur any season Status: breeds irregularly	yes	
American Wigeon	Occurrence: regular migrant, winters Status:	yes	
Canvasback	Occurrence: regular migrant Status:	yes	
Redhead	Occurrence: regular migrant, winters Status: formerly bred	yes	
Ring-necked Duck	Occurrence: regular migrant, winters Status:	yes	
Lesser Scaup	Occurrence: regular migrant, winters Status:	yes	
Hooded Merganser	Occurrence: fall vagrant Status:	yes	
Red-breasted Merganser	Occurrence: winter vagrant Status:	yes	
Ruddy Duck	Occurrence: resident Status: breeds regularly	yes	
Turkey Vulture	Occurrence: regular migrant Status:	yes	
Osprey	Occurrence: regular migrant Status:	yes	State: CSC
Northern Harrier	Occurrence: regular migrant Status:	yes	State: CSC
Sharp-shinned Hawk	Occurrence: regular migrant, winters Status:	yes	State: CSC
Cooper's Hawk	Occurrence: may occur any season Status: breeds regularly	yes	State: CSC
Broad-winged Hawk	Occurrence: Status:	yes	

Swainson's Hawk	Occurrence: Status:	yes	Federal: MNBMC
Red-tailed Hawk	Occurrence: resident Status: breeds regularly	yes	
Ferruginous Hawk	Occurrence: no record in last 15 years Status:	yes	State: CSC
American Kestrel	Occurrence: resident Status: breeds regularly	yes	
Merlin	Occurrence: regular migrant, winters Status:	yes	State: CSC
Peregrine Falcon	Occurrence: regular migrant, winters Status:	yes	Federal: MNBMC State: SE
Prairie Falcon	Occurrence: no record in last 15 years Status:	yes	State: CSC
Black Rail	Occurrence: no recent sightings Status: formerly bred	yes	Federal: MNBMC State: ST, FP
Virginia Rail	Occurrence: winter vagrant Status: formerly bred	yes	
Sora	Occurrence: regular migrant, winters Status: formerly bred	yes	
Common Moorhen	Occurrence: may occur any season Status: breeds irregularly	yes	
American Coot	Occurrence: regular migrant, winters Status: breeds regularly	yes	
Sandhill Crane	Occurrence: no record in last 15 years Status:	yes	State: FP
Black-bellied Plover	Occurrence: regular migrant Status:	yes	
Snowy Plover	Occurrence: extirpated from park Status: formerly bred	yes	Federal: MNBMC State: CSC
Semipalmated Plover	Occurrence: regular migrant, winters Status:	yes	
Killdeer	Occurrence: resident Status: breeds regularly	yes	
Mountain Plover	Occurrence: no record in last 15 years Status:	yes	Federal: FPT,MNBMC State: CSC
Black-necked Stilt	Occurrence: may occur any season Status: formerly bred	yes	
American Avocet	Occurrence: migratory vagrant Status: formerly bred	yes	
Greater Yellowlegs	Occurrence: regular migrant Status:	yes	
Lesser Yellowlegs	Occurrence: regular migrant Status:	yes	
Solitary Sandpiper	Occurrence: fall migrant Status:	yes	
Willet	Occurrence: vagrant Status:	yes	
Wandering Tattler	Occurrence: no record in last 15 years Status:	yes	
Spotted Sandpiper	Occurrence: may occur any season Status:	yes	
Whimbrel	Occurrence: regular migrant Status:	yes	
Long-billed Curlew	Occurrence: regular migrant Status:	yes	Federal: MNBMC State: CSC
Marbled Godwit	Occurrence: vagrant Status:	yes	
Ruddy Turnstone	Occurrence: no record in last 15 years Status:	yes	
Red Knot	Occurrence: fall vagrant Status:	yes	
Sanderling	Occurrence: fall vagrant Status:	yes	

Semipalmated Sandpiper	Occurrence: fall vagrant Status:	yes	
Western Sandpiper	Occurrence: regular migrant Status:	yes	
Least Sandpiper	Occurrence: regular migrant Status:	yes	
Baird's Sandpiper	Occurrence: fall vagrant Status:	yes	
Pectoral Sandpiper	Occurrence: fall vagrant Status:	yes	
Stilt Sandpiper	Occurrence: no record in last 15 years Status:	yes	
Short-billed Dowitcher	Occurrence: fall vagrant Status:	yes	
Long-billed Dowitcher	Occurrence: regular migrant, winters Status:	yes	
Common Snipe	Occurrence: winters Status:	yes	
Wilson's Phalarope	Occurrence: migratory vagrant Status:	yes	
Red-necked Phalarope	Occurrence: fall vagrant Status:	yes	
Red Phalarope	Occurrence: fall vagrant Status:	yes	
Franklin's Gull	Occurrence: Status:	yes	
Bonaparte's Gull	Occurrence: regular migrant, winters Status:	yes	
Ring-billed Gull	Occurrence: regular migrant, winters Status:	yes	
California Gull	Occurrence: may occur any season Status:	yes	
Herring Gull	Occurrence: winters Status:	yes	
Western Gull	Occurrence: may occur any season Status:	yes	
Glaucous-winged Gull	Occurrence: winters Status:	yes	
Sabine's Gull	Occurrence: no record in last 15 years Status:	yes	
Caspian Tern	Occurrence: may occur any season Status: nests nearby	yes	
Royal Tern	Occurrence: Status:	yes	
Elegant Tern	Occurrence: Status:	yes	Federal: MNBMC State: CSC
Common Tern	Occurrence: fall vagrant Status:	yes	
Forster's Tern	Occurrence: may occur any season Status:	yes	
Least Tern	Occurrence: summers Status: formerly bred, nests nearby	yes	Federal: FE, MNBMC State: SE
Black Tern	Occurrence: migratory vagrant Status:	yes	Federal: MNBMC State: CSC
Black Skimmer	Occurrence: Status:	yes	
Band-tailed Pigeon	Occurrence: winter vagrant Status:	yes	
White-winged Dove	Occurrence: fall and winter vagrant Status:	yes	
Mourning Dove	Occurrence: resident Status: breeds regularly	yes	

Yellow-billed Cuckoo	Occurrence: extirpated from park Status: formerly bred	yes	Federal: MNBMC State: SE
Burrowing Owl	Occurrence: extirpated from park Status: formerly bred	yes	Federal: MNBMC State: CSC
Short-eared Owl	Occurrence: extirpated from park Status:	yes	Federal: MNBMC State: CSC
Lesser Nighthawk	Occurrence: Status:	yes	
Common Nighthawk	Occurrence: no record in last 15 years Status:	yes	
Common Poorwill	Occurrence: migratory vagrant Status:	yes	
Black Swift	Occurrence: spring vagrant Status:	yes	Federal: MNBMC State: CSC
Chimney Swift	Occurrence: summers Status:	yes	
Vaux's Swift	Occurrence: migrant Status:	yes	Federal: MNBMC State: CSC
White-throated Swift	Occurrence: may occur any season Status: nests nearby	yes	
Black-chinned Hummingbird	Occurrence: summers, migrant Status: regularly breeds	yes	
Costa's Hummingbird	Occurrence: may occur any season Status: breeds irregularly	yes	
Anna's Hummingbird	Occurrence: resident Status: breeds regularly	yes	
Calliope Hummingbird	Occurrence: Status:	yes	
Rufous Hummingbird	Occurrence: spring migrant Status:	yes	Federal: MNBMC
Allen's Hummingbird	Occurrence: resident Status: breeds regularly	yes	
Belted Kingfisher	Occurrence: may occur any season Status:	yes	
Red-naped Sapsucker	Occurrence: winter vagrant Status:	yes	
Red-breasted Sapsucker	Occurrence: winters Status:	yes	
Olive-sided Flycatcher	Occurrence: migrant Status:	yes	Federal: MNBMC
Western Wood-Pewee	Occurrence: migrant Status:	yes	
Willow Flycatcher	Occurrence: migrant Status:	yes	State: SE
Least Flycatcher	Occurrence: fall vagrant Status:	yes	
Hammond's Flycatcher	Occurrence: migrant Status:	yes	
Dusky Flycatcher	Occurrence: fall migrant Status:	yes	
Gray Flycatcher	Occurrence: migrant Status:	yes	
Eastern Phoebe	Occurrence: no record in last 15 years Status:	yes	
Say's Phoebe	Occurrence: migrant, winters Status:	yes	
Vermilion Flycatcher	Occurrence: rarely occurs Status:	yes	State: CSC
Ash-throated Flycatcher	Occurrence: migrant Status:	yes	
Great-crested Flycatcher	Occurrence: Status:	yes	
Brown-crested Flycatcher	Occurrence: no record in last 15 years Status:	yes	State: CSC

Sulphur-bellied Flycatcher	Occurrence: no record in last 15 years Status:	yes	
Tropical Kingbird	Occurrence: fall vagrant Status:	yes	
Cassin's Kingbird	Occurrence: may occur any season Status: Status: formerly bred	yes	
Western Kingbird	Occurrence: migrant Status: formerly bred	yes	
Eastern Kingbird	Occurrence: Status:	yes	
Purple Martin	Occurrence: migratory vagrant Status:	yes	State: CSC
Tree Swallow	Occurrence: migrant Status:	yes	
Violet-green Swallow	Occurrence: migrant Status:	yes	
N.Rough-winged Swallow	Occurrence: summers, migrant Status: breeds regularly, nests nearby	yes	
Bank Swallow	Occurrence: migrant Status:	yes	State: ST
Cliff Swallow	Occurrence: summers, migrant Status: nests nearby	yes	
Barn Swallow	Occurrence: summers, migrant Status: breeds regularly, nests nearby	yes	
House Wren	Occurrence: may occur any season Status: breeds irregularly	yes	
Marsh Wren	Occurrence: resident, Status: breeds regularly	yes	
Ruby-crowned Kinglet	Occurrence: winters Status:	yes	
Blue-gray Gnatcatcher	Occurrence: winters, migrant Status:	yes	
Western Bluebird	Occurrence: Status:	yes	
Mountain Bluebird	Occurrence: Status:	yes	
Townsend's Solitaire	Occurrence: no record in last 15 years Status:	yes	
Swainson's Thrush	Occurrence: summers, igrant Status: breeds irregularly	yes	
Hermit Thrush	Occurrence: winters, migrant Status:	yes	
Wood Thrush	Occurrence: Status:	yes	
American Robin	Occurrence: resident, Status: breeds regularly	yes	
Sage Thrasher	Occurrence: no record in last 15 years Status:	yes	
American (Water) Pipit	Occurrence: winters, migrant Status:	yes	
Cedar Waxwing	Occurrence: winters, migrant Status:	yes	
Loggerhead Shrike	Occurrence: resident Status: breeds regularly	yes	State: CSC
Bell's Vireo (least Bell's?)	Occurrence: extirpated from park Status: formerly bred	yes	Federal: FE, MNBMC State: SE
Warbling Vireo	Occurrence: migrant Status:	yes	
Philadelphia Vireo	Occurrence: Status:	yes	
Red-eyed Vireo	Occurrence: Status:	yes	

Tennessee Warbler	Occurrence: fall vagrant Status:	yes	
Nashville Warbler	Occurrence: migrant Status:	yes	
Virginia's Warbler	Occurrence: fall vagrant Status:	yes	State: CSC
Lucy's Warbler	Occurrence: Status:	yes	Federal: MNBMC
Northern Parula	Occurrence: Status:	yes	
Yellow Warbler	Occurrence: may occur any season Status: breeds irregularly	yes	State: CSC
Chestnut-sided Warbler	Occurrence: occurs rarely Status:	yes	
Magnolia Warbler	Occurrence: occurs rarely Status:	yes	
Yellow-rumped (Myrtle) Warbler	Occurrence: winters Status:	yes	
Audubon's (Yellow-rumped) Warbler	Occurrence: winter, migrant Status:	yes	
Black-throated Gray Warbler	Occurrence: winter, migrant Status:	yes	
Townsend's Warbler	Occurrence: winter, migrant Status:	yes	
Hermit Warbler	Occurrence: migrant Status:	yes	
Black-throated Green Warbler	Occurrence: no record in last 15 years Status:	yes	
Blackburnian Warbler	Occurrence: occurs rarely Status:	yes	
Prairie Warbler	Occurrence: no record in last 15 years Status:	yes	
Palm Warbler	Occurrence: fall and winter vagrant Status:	yes	
Bay-breasted Warbler	Occurrence: occurs rarely Status:	yes	
Blackpoll Warbler	Occurrence: fall vagrant, occurs rarely Status:	yes	
Black-and-White Warbler	Occurrence: vagrant, occurs rarely Status:	yes	
American Redstart	Occurrence: vagrant, occurs rarely Status:	yes	
Prothonotary Warbler	Occurrence: Status:	yes	
Worm-eating Warbler	Occurrence: occurs rarely Status:	yes	
Ovenbird	Occurrence: Status:	yes	
Northern Waterthrush	Occurrence: fall vagrant Status:	yes	
Mourning Warbler	Occurrence: Status:	yes	
MacGillivray's Warbler	Occurrence: migrant Status:	yes	
Common Yellowthroat	Occurrence: resident Status: breeds regularly	yes	State: CSC
Hooded Warbler	Occurrence: no record in last 15 years Status:	yes	
Wilson's Warbler	Occurrence: migrant Status:	yes	
Canada Warbler	Occurrence: occurs rarely Status:	yes	
Yellow-breasted Chat	Occurrence: migratory vagrant Status: formerly bred	yes	State: CSC

Summer Tanager	Occurrence: vagrant Status:	yes	State: CSC
Western Tanager	Occurrence: migrant Status:	yes	
Rose-breasted Grosbeak	Occurrence: migratory vagrant Status:	yes	
Black-headed Grosbeak	Occurrence: migrant Status:	yes	
Blue Grosbeak	Occurrence: migrant Status: formerly bred	yes	
Lazuli Bunting	Occurrence: migrant Status:	yes	
Indigo Bunting	Occurrence: vagrant Status:	yes	
Painted Bunting	Occurrence: Status:	yes	
Dicksissel	Occurrence: Status:	yes	
Green-tailed Towhee	Occurrence: winter vagrant Status:	yes	
Rufous-crowned Sparrow	Occurrence: no record in last 15 years Status:	yes	State: CSC
Chipping Sparrow	Occurrence: migrant Status:	yes	
Clay-colored Sparrow	Occurrence: fall vagrant Status:	yes	
Brewer's Sparrow	Occurrence: fall migrant Status:	yes	
Black-chinned Sparrow	Occurrence: no record in last 15 years Status:	yes	
Vesper Sparrow	Occurrence: vagrant Status:	yes	
Lark Sparrow	Occurrence: fall migrant Status:	yes	
Lark Bunting	Occurrence: no record in last 15 years Status:	yes	
Savannah Sparrow (nevad.)	Occurrence: winters, migrant Status:	yes	
Grasshopper Sparrow	Occurrence: no record in last 15 years Status: formerly bred	yes	Federal: MBNMC
Lincoln's Sparrow	Occurrence: winters, migrant Status:	yes	
Swamp Sparrow	Occurrence: winter vagrant Status:	yes	
White-crowned Sparrow	Occurrence: winters, migrant Status:	yes	
Bobolink	Occurrence: fall vagrant Status:	yes	
Red-winged Blackbird	Occurrence: resident Status: breeds regularly	yes	
Western Meadowlark	Occurrence: winters, migrant Status: formerly bred	yes	
Yellow-headed Blackbird	Occurrence: summers, fall Status: formerly bred	yes	
Brewer's Blackbird	Occurrence: resident Status: breeds regularly	yes	
Brown-headed Cowbird	Occurrence: may occur any season Status: breeds regularly	yes	
Orchard Oriole	Occurrence: Status:	yes	
Hooded Oriole	Occurrence: summers, migrant Status: breeds regularly	yes	
Bullock's Oriole (northern)	Occurrence: summers, migrant Status: breeds regularly	yes	

Baltimore Oriole (northern)	Occurrence: Status:	yes	
Scott's Oriole	Occurrence: no record in last 15 years Status:	yes	
Lesser Goldfinch	Occurrence: resident Status: breeds regularly	yes	
American Goldfinch	Occurrence: resident Status: breeds regularly	yes	
Hypothetical List			
Broad-tailed Hummingbird	Occurrence: Status:	yes	
Yellow-bellied Sapsucker	Occurrence: Status:	yes	
Cave Swallow	Occurrence: Status:	yes	
Cape May Warbler	Occurrence: Status:	yes	
Pine Warbler	Occurrence: Status:	yes	
Connecticut Warbler	Occurrence: Status:	yes	
Scarlet Tanager	Occurrence: Status:	yes	

MBTA = Migratory Bird Treaty Act
Special Status Codes:
FE = federal endangered
FPT = federal proposed threatened
MNBMC = US Fish and Wildlife Service migratory nongame bird of management concern
SE = state endangered
ST = state threatened
CSC = Dept. of Fish and Game species of special concern
FP = Dept. of Fish and Game fully protected species

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Urban Sky Glow and the Lighting of the Vincent Thomas Bridge

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Executive Summary

This report is in response to concerns regarding the proposed lighting of the Vincent Thomas Bridge in Long Beach, CA. The two principal concerns are that the proposed lighting may: 1) lead to excessive urban sky glow, and 2) have a negative impact on migratory birds. This report addresses the first concern – urban sky glow.

Two techniques were used to study the impact of lighting the Vincent Thomas bridge on sky glow: 1) direct measurements of sky luminance in the region around the Port of Los Angeles, and 2) estimation of the increase in sky glow at Palomar Observatory that would likely result from the proposed lighting.

Measurements of direct sky luminance were taken at seven ground locations in the vicinity of the Vincent Thomas Bridge. Forty-eight luminance measurements were taken at each ground location for a total of 336 measurements. A standard protocol was used to allow comparisons between the different measurement locations. The grand mean of all 336 sky luminance measurements was 0.088 cd/m^2. The mean sky luminance ranged from a maximum of 0.188 cd/m^2 at a ground location east of the bridge and just north of Route 47, to a minimum of 0.013 cd/m^2 at ground location within the Bolsa Chica Wetlands. This ratio is greater than 14:1. In general, the closer the ground location was to the Port of Los Angeles, the higher the mean sky luminance. At ground locations near the Port of Los Angeles, the sky luminance was greater in the direction of the port and lesser in directions away from the port. This suggests that the increase in mean sky luminance is due to the significant amount of existing lighting at the port. There is compelling quantitative evidence that the sky above the Port of Los Angeles is considerably brighter than the sky in the surrounding areas. These data support visual observations made during the surveys.

The incremental increase in urban sky glow as a result of the proposed lighting was estimated using "Walker's Law". Using the most conservative assumptions, it was estimated that at the Palomar Observatory the proposed lighting would increase sky glow by 0.029%. Using less conservative and more realistic assumptions, the increase was estimated to be less than 0.008%.

Despite these conclusions, minimizing environmental impacts is an important part of responsible outdoor lighting design. Techniques for lessening the environmental impact of the lighting for the Vincent Thomas Bridge are suggested.

Table of Contents

Executive Summary ii

Table of Contents iii

1. Introduction 1

2. Direct Measurements of Sky Glow 1

   2.1. Measurement Methods 2

   2.2. Measurement Results 3

3. Estimates of Sky Glow at Palomar Observatory 4

4. General Discussion 5

5. Conclusions 6

References 7

Appendix – Completed Sky Luminance Survey Forms

   Set-up ONE: Due south of west tower of the Vincent Thomas Bridge 9

   Set-up TWO: California Transit's tollbooth lot east of the Vincent Thomas Bridge . 11

   Set-up THREE: Due west of the Vincent Thomas Bridge near the channel street off-ramp of the 110 Freeway 13

   Set-up FOUR: Top of Signal Hill 15

   Set-up FIVE: Bolsa Chica Wetlands at PCH and Warner 17

   Set-up SIX: Top of Signal Hill 19

   Set-up SEVEN: Near the Queensway Bay Lighthouse 21

1. Introduction

The term "sky glow" is used to describe the added sky brightness from the scattering of electrically generated light in the atmosphere; the primary cause is outdoor lighting in urban areas. Methods have been suggested for estimating sky glow,[1-3] but it is difficult to calculate on an absolute scale with a high degree of certainty. It is possible, however, to directly measure the luminance of the sky. Direct measurements can be used to quantify existing sky glow at a specific time and under the existing conditions.

Two techniques were used to study the impact of lighting the Vincent Thomas bridge on sky glow: 1) direct measurements of sky luminance in the region around the Port of Los Angeles, and 2) estimation of the increase in sky glow at Palomar Observatory that would likely result from the proposed lighting.

2. Direct Measurements of Sky Glow

Luminance is defined as the luminous intensity in the direction of an observer divided by the area of the surface seen by the observer. With respect to sky luminance, the "surface" is complex and is comprised of the particulates in the sky that reflect light back toward earth. The area can be the entire hemisphere of the sky or a segment of the sky. The advantage of segmenting the sky is that the distribution sky luminance can be studied as a function of altitude and azimuth angles. In this way, it is possible to rank ground locations with respect to their contribution to sky glow in a given region.

A two dimensional map of the sky hemisphere is given as *Figure 1*, which illustrates how the hemisphere of the sky was divided for this study; it was segmented using a grid defined by eight azimuth angles in 45° increments and six altitude angles in 15° increments. The eight azimuth angles were: 0° (magnetic north*), 45° (NE), 90° (E), 135° (SE), 180° (S), 225° (SW), 270° (W), and 315° (NW). At each azimuth angle the six altitude angles were: 15° from the horizon, 30°, 45°, 60°, 75°, and 90° (zenith). A luminance measurement was taken at each intersection of altitude and azimuth angles using a Minolta LS-100 luminance meter with a 1° acceptance angle. This resulted in 48 sky luminance measurements for each ground location.

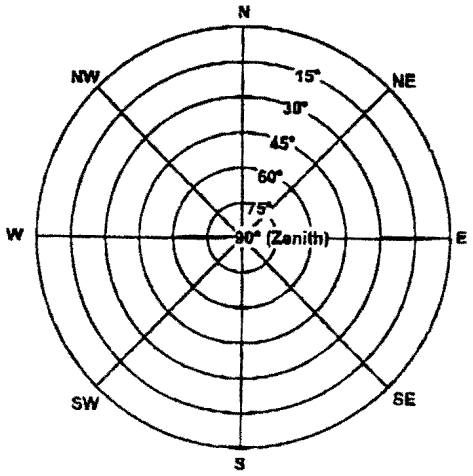


Figure 1: Two-dimensional map of the sky hemisphere. Each intersection of altitude and azimuth angles represents a sky luminance measurement location.

* Note: All measurements were taken with respect to magnetic north. Unless otherwise noted, north in this document means magnetic north and all other compass directions are with respect to magnetic north. As a point of reference, the declination angle for Long Beach, CA is 15°, which means that "true north" is 15° west of magnetic north.

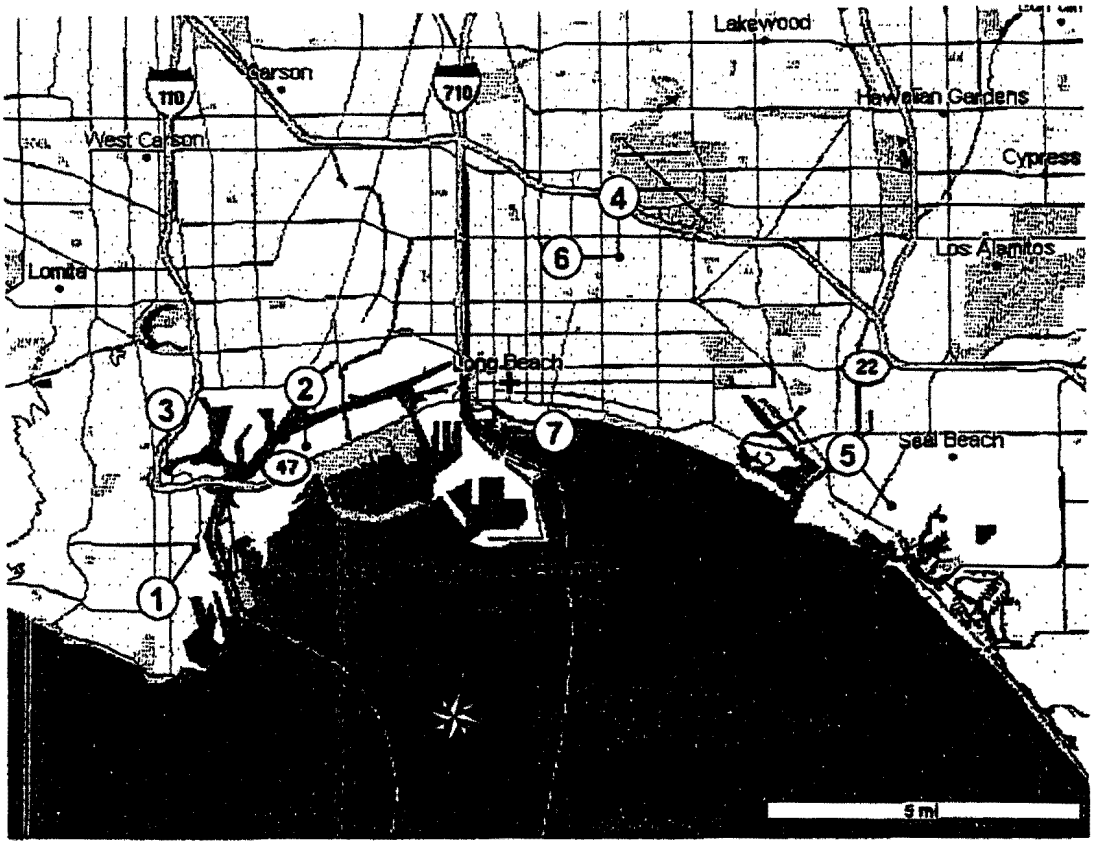


Figure 2: The seven ground locations for the measurements of sky luminance.

Measurements of direct sky luminance were taken at seven ground locations in the vicinity of the Vincent Thomas Bridge. The ground locations are given in *Figure 2*. In total, 336 sky luminance measurements were taken (7 ground locations × 48 measurements per ground location = 336 measurements). These data allow us to study the distribution of the sky luminance and determine the regions of the sky that are comparatively dark and the regions that are comparatively bright.

2.1. Measurement Methods

A survey form and protocol was developed to standardize the procedure for measuring sky luminance. The entire set of completed survey forms is given in *Appendix A*. Each of the seven surveys consisted of the following steps:

Step 1 Set up a tripod and attach the luminance meter.

Step 2 Find magnetic north using a sighting compass, and orient the luminance meter toward magnetic north.

Step 3 Level the luminance meter on all axes.

Step 4 Adjust the luminance meter to a 15° altitude angle using the tripod head and verifying the inclination with a clinometer.

Step 5 Record the site conditions, including the cloud cover, estimation of particulates in the atmosphere, temperature, relative humidity, latitude, longitude, elevation, and start time for luminance measurements.

Step 6 Take and record the first direct sky luminance measurement. [Note: no measurements were taken until after astronomical twilight and after the moon had set].

Step 7 Increase the altitude angle in 15° increments to 30°, 45°, 60°, 75°, and 90° recording the direct sky luminance at each position.

Step 8 Rotate the luminance meter to a northeast bearing (45°), level the meter, and measure direct sky luminance at the same set of altitude angles.

Step 9 Repeat this process for all eight azimuth angles.

Step 10 Record general site conditions including any changes in temperature, humidity, and/or cloud cover and the end time for luminance measurements.

The weather conditions were fairly consistent over the two nights but did vary slightly with ground location. In all cases the temperature was in the 60's and the sky was hazy. Humidity ranged from 40% - 67%. There were some wispy clouds in the sky during measurements ONE and SEVEN that drifted during the course of the measurements. All other measurements were taken under cloudless skies with uniform haze.

2.2. Measurement Results

The grand mean of all 336 sky luminance measurements is 0.088 cd/m^2. *Figure 3* summarizes the data by showing at each ground location: 1) mean sky luminance across all 48 altitude and azimuth angles, and 2) the compass direction with the greatest mean sky luminance across all 6 altitude angles, and the corresponding value for mean luminance in that direction.

The mean sky luminance ranges from a maximum of 0.188 at ground location TWO (east of the bridge just north of Route 47) to a minimum of 0.013 at ground location FIVE (Bolsa Chica Wetlands). This ratio is greater than 14:1. In general, the closer the ground location was to the Port of Los Angeles, the higher the mean sky luminance. The mean sky luminances at ground locations ONE, TWO, THREE and SEVEN – which were closest to the Port of Los Angeles – were each greater than the overall mean. Mean sky luminances at ground locations FOUR, FIVE and SIX – which were furthest from the Port of Los Angeles – were each less than the overall mean. The collective mean sky luminance at ground locations ONE, TWO, THREE and SEVEN was 0.128 cd/m^2, whereas the collective mean luminance at ground locations FOUR, FIVE and SIX was 0.035 cd/m^2. This ratio is greater than 3.5:1.

At location ONE, TWO, THREE and SEVEN the sky luminance was greater toward the Port of Los Angeles, and lesser in directions away from the port. This suggests that the increase in mean sky luminance at those locations is due to the significant amount of existing lighting at the port.

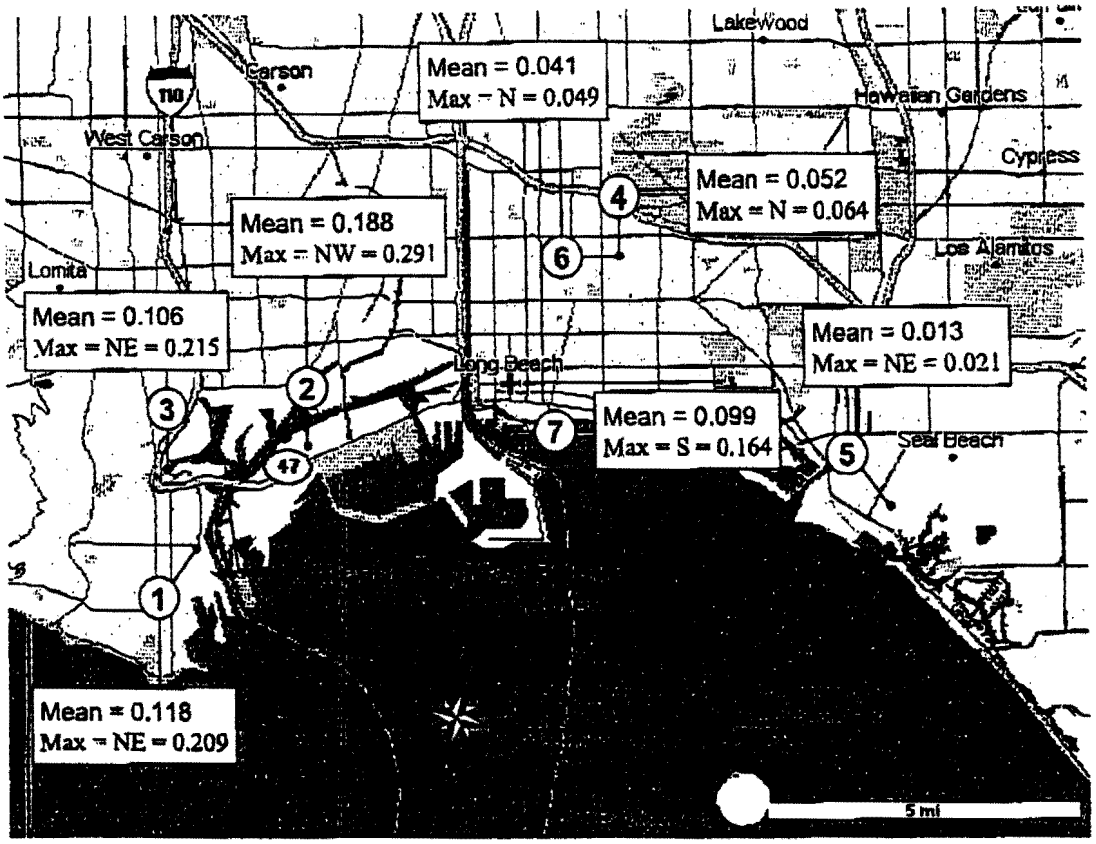


Figure 3: Summary of the sky luminance measurements. The mean sky luminances across all 48 altitude and azimuth angles are shown in **ARIAL FONT**. The compass directions with the greatest mean sky luminance across all 6 altitude angles, and the corresponding values for mean luminance in that direction, are shown in **TIMES FONT**. All values are in cd/m^2.

There is compelling quantitative evidence that the sky above the Port of Los Angeles is considerably brighter than the sky in the surrounding areas. These data support visual observations made during the surveys. Both subjectively and quantitatively, the sky above the Port of Los Angeles is bright relative to the surrounding areas. The complete raw data are given in *Appendix A*, and can be referenced for additional information.

3. Estimates of Sky Glow at Palomar Observatory

"Walkers Law" is an empirical formula used to estimate urban sky glow at an astronomical observing site.[2,3] The basic formula is:

$$I = 0.01\ Pd^{-2.5}$$

Where: I = Percentage increase in sky glow level above the natural background
P = Population of the city (including metropolitan areas)
D = Distance to the center of the city in kilometers

As can be inferred from the formula, Walker's Law is based on two variables: 1) population, and 2) distance between the city center and the observation site. In order to

use Walker's Law, it is necessary to convert the proposed bridge lighting into an equivalent incremental increase in population. According to the International Dark Sky Association, Walker's Law "seems to best fit communities where the average lumens per person is between 500 and 1000." Using this as a guide, it is possible to relate the proposed lumens used to light the bridge to an incremental increase in population. The total number of initial lumens exiting the proposed fixtures is 3,712,000[†]. We can conservatively assume that every 500 lumens would be equivalent to an increase of one person in the variable "P" of Walker's Law. Therefore, for the purpose of utilizing Walker's Law, the proposed lighting would be equivalent to a population increase of 7,424 people.

The United States Census Bureau estimates that the population of the Los Angeles metropolitan area is 15,781,237.[5] Palomar Observatory is located about 145 kilometers southeast of Los Angeles. Using this information we can apply Walker's Law, as follows:

Without the Proposed Lighting:

$$I_{without} = 0.01\ (15{,}781{,}237)(145)^{-2.5} = 0.62333432 = 62.33\%$$

With the Proposed Lighting:

$$I_{with} = 0.01\ (15{,}788{,}661)(145)^{-2.5} = 0.62362755 = 62.36\%$$

The first value ($I_{without}$) means that the sky glow at a 45° altitude angle in the direction of Los Angeles is 62.33% greater than the natural background.[2] With the proposed lighting, the sky glow would increase by just 0.029%. These two values are nearly equivalent.

The above analysis is the most conservative possible for three reasons: 1) the lumen values are based on the initial output of all light sources, 2) large cities emit more light per person than the 500 lumens assumed in the analysis,[2] and 3) this analysis assumes that all of the lumens exiting the luminaires shine directly into the sky. Because of these conservative assumptions, the increase in sky glow is likely to be much smaller than 0.029%, and would probably be less than 0.008%.

4. General Discussion

It is unrealistic and unnecessary to eliminate outdoor lighting. Rather, the objective should be to light the outdoors responsibly and to minimize environmental impacts. Responsible lighting designs maximize visual impressions with minimum impact on our natural resources, including the night sky.

There are two mechanisms that can cause an increase in sky glow: 1) an increase in atmospheric particulates, and 2) additional lighting spilling into the atmosphere. If lighting is held constant, the magnitude of sky glow is a function of the atmospheric conditions at any fixed ground location. An increase in atmospheric particulates may result from an increase in pollution, clouds, humidity, and/or other airborne matter. For

[†] Refer to the lighting fixture schedule prepared by Lighting Design Alliance. The quantity of each fixture and the fixture lumen output are as follows: 1) 4 type F2 with 14,000 lumens each, 2) 8 type F3 with 115,000 lumens each, 3) 160 type F4 with 1,350 lumens each, and 4) 8 type F6 with 315,000 lumens each.

example, sky glow would be more noticeable under an overcast sky versus a clear sky. It is important to note, however, that the trends and ratios cited above would not change significantly.

All lighting that spills into the atmosphere contributes to sky glow, and may be obtrusive. Obtrusive light has been defined as "Unwanted light, which because of quantitative, directional, or spectral attributes, in a given context, gives rise to annoyance, discomfort, distraction, or a reduction in the ability to see essential information".[4] This definition provides useful guidance for evaluating whether a planned lighting installation will or will not create obtrusive light.

The geographic *context* for the Vincent Thomas Bridge is an area that is already very bright. Because of the current high levels of brightness at the Port of Los Angeles, it is thought that the proposed bridge lighting will not significantly increase the urban sky glow in that region.

In line with the above definition, the *directional* attributes of the lighting should be controlled. The best strategy is to select fixtures with good optics and shielding so that the intended surfaces are lighted with minimum stray light. Light emissions above 90° should also be minimized.

For visitors and members of the Los Angeles community, the *essential information* is the bridge itself, and the proposed lighting will enhance its appearance. For astronomers, the *essential information* is contained in the night sky. Even with responsible design that utilizes fixtures with good optics and shielding, light will invariably spill into the atmosphere. This can be dealt with by switching the bridge lighting off at times convenient to astronomers, which is strongly recommended.

To summarize, the following are lighting strategies that can be implemented to minimize urban sky glow:

1. Turn the lighting off when it is not needed.
2. Minimize spill light by using luminaires with appropriate optics and good shielding.
3. Minimize light emission above 90°.

5. Conclusions

Significant sky glow was visually observed at the port of Los Angeles and verified quantitatively with direct measurements of sky luminance. The night sky above the port of Los Angeles is very bright, and will remain so apart from the decision regarding the lighting of the Vincent Thomas Bridge. The incremental increase in urban sky glow as a result of the proposed lighting is very small. At the Palomar Observatory, it is estimated that the increase would be less than 0.008%. Environmental concerns about urban sky glow must be considered within the context of all criteria, including the goal of creating an artistic and symbolic gateway to the city of Los Angeles. Employing the strategies mentioned above could moderate the environmental impact while maintaining the nighttime visual impact of the Vincent Thomas Bridge.

References

1. CIE 126 "Guidelines for Minimizing Sky Glow" Commission Internationale de l'Éclairage. Vienna: Central Bureau of the CIE. 1997.
2. International Dark-Sky- Association "Estimating the Level of Sky Glow Due to Cities" Information Sheet 11, 1996.
3. International Dark-Sky Association "More About Sky Glow Calculations Using Walker's Law" Information Sheet 112, 1996.
4. Lewin, Ian "Light Trespass Research" EPRI Report Number TR-114914, 2000.
5. United States Census Bureau "Metropolitan Area Population Estimates for July 1, 1998", http://www.census.gov/population/estimates/metro-city/ma98-01.txt.

Appendix – Completed Sky Luminance Survey Forms

Nighttime Sky Luminance Survey Form

ONE

General Information and Purpose for Survey: Evaluation of Urban Sky Glow in the region around the Vincent Thomas Bridge in Long Beach, CA. This set-up is due south of west tower of the bridge at 1st Street.

Table 1: **Client Contact Information.**

Organization:	Lighting Design Alliance
Contact Name:	Chip Israel / Julie Reeves
Address:	1234 East Burnett Street
	Long Beach, CA 90806
Phone:	(562) 989-3843
Fax:	(562) 989-3847
Email:	

Table 2: **Surveyor Contact Information.**

Organization:	
Survey by:	Kevin Houser
Address	1302 N. 112 CT, #5907
	Omaha, NE 68154
Phone	(402) 554-3858
Fax:	(402) 554-2309
Email:	khouser@unl.edu

Table 3: **Instruments.**

Measurement	Manufacturer	Model Name	Published Accuracy
Luminance	Minolta	LS-100, 1° spot (SN 78913010)	± 2%, ± 2 digits
Altitude Angle	Brunton	Clino Master (SN 943551)	± 1°, ± 2%
Compass Direction	Brunton	Sight Master (SN 742011)	± 1/2° to Magentic North
Geographic Location	Garmin	Etrex GPS	15 meters (49 ft)
Elevation (relative to sea level)	Garmin	Etrex GPS	15 meters (49 ft)
Temperature	RadioShack	Digital Thermo-Hygro	2° F
Relative Humidity	RadioShack	Digital Thermo-Hygro	± 5% RH 40% to 80%
Tripod Head	Bogen	Junior Geared Head (Model 3275)	N/A
Tripod Body	ProMaster	Model 6600	N/A

Table 4: **General Site Conditions and Information.**

Date	30-Sep-00 (Saturday)		Twilight (Astronomical)	5:23 AM
Time*	Start: 8:55 PM	End: 9:17 PM	Twilight	6:21 AM
Cloud Cover**	S: Very Cloudy/Hazy	E: Very Cloudy/Hazy	Sun Rise	6:46 AM
Particulates***	S: Moderate	E: Moderate	Sun Set	6:39 PM
Temperature	S: 66° F	E: 66° F	Twilight	7:04 P
Relative Humidity	S: 47%	E: 47%	Twilight (Astronomical)	8:02 P
Latitude	33° 44.603'		Moon Rise	9:38 P
Longitude	-118° 16.758'		Moon Set	8:50 I
Elevation	-13 Feet		Last New Moon	27-Sep

* For Measurements of Sky Luminance

** Clear, Somewhat Cloudy, Partly Cloudy, Very Cloudy, Overcast

*** Few, Moderate, Dense

ONE

Table 5: **Direct Sky Luminance Measurements.**

Altitude Angle	Compass Direction								Row Mean	Row Std. Dev.
	N (0°)	NE (45°)	E (90°)	SE (135°)	S (180°)	SW (225°)	W (270°)	NW (315°)		
15°	0.370	0.579	0.443	0.274	0.166	0.174	0.198	0.288	0.370	0.145
30°	0.160	0.324	0.210	0.148	0.087	0.101	0.119	0.133	0.160	0.076
45°	0.095	0.162	0.097	0.072	0.065	0.059	0.074	0.063	0.095	0.034
60°	0.069	0.081	0.053	0.050	0.063	0.041	0.060	0.045	0.069	0.013
75°	0.047	0.061	0.041	0.041	0.051	0.040	0.048	0.040	0.047	0.007
90° (zenith)	0.046	0.046	0.037	0.044	0.062	0.043	0.044	0.040	0.046	0.007
Column Mean	0.131	0.209	0.147	0.105	0.082	0.076	0.091	0.102	0.118	Grand Std. Dev.
Column Std. Dev.	0.124	0.208	0.159	0.092	0.043	0.053	0.059	0.098	Grand Mean	0.116

Units: cd/m^2

General Comments & Observations: Hole in the cloud cover directly overhead. More haze toward to east and north. All cranes are off except four to due east that are aimed down. The parking lot adjacent to 1st street has all lights off. When arrived (8:50 PM) no stars were visible, stars overhead were visible at end of survey (9:17 PM).

Nighttime Sky Luminance Survey Form

TWO

General Information and Purpose for Survey: Evaluation of Urban Sky Glow in the region around the Vincent Thomas Bridge in Long Beach, CA. This set-up is in California Transit's toll booth lot, east of the bridge. Route 47 is directly south.

Table 1: **Client Contact Information.**

Organization:	Lighting Design Alliance
Contact Name:	Chip Israel / Julie Reeves
Address:	1234 East Burnett Street
	Long Beach, CA 90806
Phone:	(562) 989-3843
Fax:	(562) 989-3847
Email:	

Table 2: **Surveyor Contact Information.**

Organization:	
Survey by:	Kevin Houser
Address	1302 N. 112 CT, #5907
	Omaha, NE 68154
Phone	(402) 554-3858
Fax:	(402) 554-2309
Email:	khouser@unl.edu

Table 3: **Instruments.**

Measurement	Manufacturer	Model Name	Published Accuracy
Luminance	Minolta	LS-100, 1° spot (SN 78913010)	± 2%, ± 2 digits
Altitude Angle	Brunton	Clino Master (SN 943551)	± 1°, ± 2%
Compass Direction	Brunton	Sight Master (SN 742011)	± 1/2° to Magentic North
Geographic Location	Garmin	Etrex GPS	15 meters (49 ft)
Elevation (relative to sea level)	Garmin	Etrex GPS	15 meters (49 ft)
Temperature	RadioShack	Digital Thermo-Hygro	2° F
Relative Humidity	RadioShack	Digital Thermo-Hygro	± 5% RH 40% to 80%
Tripod Head	Bogen	Junior Geared Head (Model 3275)	N/A
Tripod Body	ProMaster	Model 6600	N/A

Table 4: **General Site Conditions and Information.**

Date	30-Sep-00 (Saturday)		Twilight (Astronomical)	5:23 AM
Time*	Start: 9:36 PM	End: 10:00 PM	Twilight	6:21 AM
Cloud Cover**	S: See Reverse	E: See Reverse	Sun Rise	6:46 AM
Particulates***	S: Moderate	E: Moderate	Sun Set	6:39 PM
Temperature	S: 66° F	E: 66° F	Twilight	7:04 PM
Relative Humidity	S: 47%	E: 47%	Twilight (Astronomical)	8:02 PM
Latitude	33° 45.078'		Moon Rise	9:38 PM
Longitude	-118° 15.493'		Moon Set	8:50 PM
Elevation	20 Feet		Last New Moon	27-Sep-00

* For Measurements of Sky Luminance

** Clear, Somewhat Cloudy, Partly Cloudy, Very Cloudy, Overcast

*** Few, Moderate, Dense

TWO

Table 5: **Direct Sky Luminance Measurements.**

Altitude Angle	Compass Direction								Row Mean	Row Std. Dev.
	N (0°)	NE (45°)	E (90°)	SE (135°)	S (180°)	SW (225°)	W (270°)	NW (315°)		
15°	1.009	0.392	0.261	0.282	0.393	0.488	0.808	1.109	1.009	0.335
30°	0.285	0.160	0.101	0.125	0.218	0.281	0.280	0.311	0.285	0.082
45°	0.133	0.089	0.068	0.079	0.167	0.202	0.125	0.130	0.133	0.045
60°	0.075	0.065	0.056	0.064	0.092	0.103	0.080	0.078	0.075	0.015
75°	0.060	0.055	0.055	0.059	0.063	0.068	0.063	0.061	0.060	0.004
90° (zenith)	0.058	0.058	0.058	0.059	0.054	0.055	0.054	0.058	0.058	0.002
Column Mean	0.270	0.137	0.100	0.111	0.165	0.200	0.235	0.291	0.188	Grand Std. Dev.
Column Std. Dev.	0.372	0.131	0.081	0.087	0.129	0.166	0.293	0.412	Grand Mean	0.234

Units: cd/m^2

General Comments & Observations: There is a storage lot to the north with high mast lighting. Some light haze is present, mostly uniform with more at the horizon and less at zenith.

Nighttime Sky Luminance Survey Form

THREE

General Information and Purpose for Survey: Evaluation of Urban Sky Glow in the region around the Vincent Thomas Bridge in Long Beach, CA. This set-up is due west of the bridge near the channel street off ramp of the 110 freeway.

Table 1: **Client Contact Information.**

Organization:	Lighting Design Alliance
Contact Name:	Chip Israel / Julie Reeves
Address:	1234 East Burnett Street
	Long Beach, CA 90806
Phone:	(562) 989-3843
Fax:	(562) 989-3847
Email:	

Table 2: **Surveyor Contact Information.**

Organization:	
Survey by:	Kevin Houser
Address	1302 N. 112 CT, #5907
	Omaha, NE 68154
Phone	(402) 554-3858
Fax:	(402) 554-2309
Email:	khouser@unl.edu

Table 3: **Instruments.**

Measurement	Manufacturer	Model Name	Published Accuracy
Luminance	Minolta	LS-100, 1° spot (SN 78913010)	± 2%, ± 2 digits
Altitude Angle	Brunton	Clino Master (SN 943551)	± 1°, ± 2%
Compass Direction	Brunton	Sight Master (SN 742011)	± 1/2° to Magentic North
Geographic Location	Garmin	Etrex GPS	15 meters (49 ft)
Elevation (relative to sea level)	Garmin	Etrex GPS	15 meters (49 ft)
Temperature	RadioShack	Digital Thermo-Hygro	2° F
Relative Humidity	RadioShack	Digital Thermo-Hygro	± 5% RH 40% to 80%
Tripod Head	Bogen	Junior Geared Head (Model 3275)	N/A
Tripod Body	ProMaster	Model 6600	N/A

Table 4: **General Site Conditions and Information.**

Date	30-Sep-00 (Saturday)		Twilight (Astronomical)	5:23 AM
Time*	Start: 10:20 PM	End: 10:45 PM	Twilight	6:21 AM
Cloud Cover**	S: Clear	E: Clear	Sun Rise	6:46 AM
Particulates***	S: Moderate	E: Moderate	Sun Set	6:39 PM
Temperature	S: 64° F	E: 64° F	Twilight	7:04 PM
Relative Humidity	S: 47%	E: 47%	Twilight (Astronomical)	8:02 PM
Latitude	33° 45.348'		Moon Rise	9:38 PM
Longitude	-118° 17.379'		Moon Set	8:50 PM
Elevation	18 Feet		Last New Moon	27-Sep-00

* For Measurements of Sky Luminance

** Clear, Somewhat Cloudy, Partly Cloudy, Very Cloudy, Overcast

*** Few, Moderate, Dense

THREE

Table 5: **Direct Sky Luminance Measurements.**

Altitude Angle	Compass Direction								Row Mean	Row Std. Dev.
	N (0°)	NE (45°)	E (90°)	SE (135°)	S (180°)	SW (225°)	W (270°)	NW (315°)		
15°	0.449	0.749	0.532	0.221	0.124	0.110	0.116	0.166	0.449	0.240
30°	0.308	0.289	0.187	0.099	0.062	0.059	0.065	0.090	0.308	0.103
45°	0.105	0.121	0.087	0.057	0.044	0.040	0.043	0.054	0.105	0.031
60°	0.056	0.059	0.051	0.040	0.034	0.034	0.034	0.039	0.056	0.010
75°	0.038	0.039	0.040	0.034	0.032	0.031	0.032	0.033	0.038	0.004
90° (zenith)	0.033	0.034	0.034	0.033	0.033	0.033	0.032	0.031	0.033	0.001
Column Mean	0.165	0.215	0.155	0.081	0.055	0.051	0.054	0.069	0.106	Grand Std. Dev.
Column Std. Dev.	0.173	0.278	0.193	0.073	0.036	0.031	0.033	0.052	Grand Mean	0.142

Units: cd/m^2

General Comments & Observations: Clear with light mist overhead. No clouds, just haze. There is a large parking lot to the northeast with massive overhead masts that appears to be contributing to local sky glow in this area.

Nighttime Sky Luminance Survey Form

FOUR

General Information and Purpose for Survey: Evaluation of Urban Sky Glow in the region around the Vincent Thomas Bridge in Long Beach, CA. This set-up is at the top of Signal Hill.

Table 1: **Client Contact Information.**

Organization:	Lighting Design Alliance
Contact Name:	Chip Israel / Julie Reeves
Address:	1234 East Burnett Street
	Long Beach, CA 90806
Phone:	(562) 989-3843
Fax:	(562) 989-3847
Email:	

Table 2: **Surveyor Contact Information.**

Organization:	
Survey by:	Kevin Houser
Address	1302 N. 112 CT, #5907
	Omaha, NE 68154
Phone	(402) 554-3858
Fax:	(402) 554-2309
Email:	khouser@unl.edu

Table 3: **Instruments.**

Measurement	Manufacturer	Model Name	Published Accuracy
Luminance	Minolta	LS-100, 1° spot (SN 78913010)	± 2%, ± 2 digits
Altitude Angle	Brunton	Clino Master (SN 943551)	± 1°, ± 2%
Compass Direction	Brunton	Sight Master (SN 742011)	± 1/2° to Magentic North
Geographic Location	Garmin	Etrex GPS	15 meters (49 ft)
Elevation (relative to sea level)	Garmin	Etrex GPS	15 meters (49 ft)
Temperature	RadioShack	Digital Thermo-Hygro	2° F
Relative Humidity	RadioShack	Digital Thermo-Hygro	± 5% RH 40% to 80%
Tripod Head	Bogen	Junior Geared Head (Model 3275)	N/A
Tripod Body	ProMaster	Model 6600	N/A

Table 4: **General Site Conditions and Information.**

Date	30-Sep-00 (Saturday)		Twilight (Astronomical)	5:23 AM
Time*	Start: 11:15 PM	End: 11:45 PM	Twilight	6:21 AM
Cloud Cover**	S: Clear, Some Haze	E: Clear, Some Haze	Sun Rise	6:46 AM
Particulates***	S: Moderate	E: Moderate	Sun Set	6:39 PM
Temperature	S: 61° F	E: 61° F	Twilight	7:04 PM
Relative Humidity	S: 67%	E: 67%	Twilight (Astronomical)	8:02 PM
Latitude	33° 47.958'		Moon Rise	9:38 PM
Longitude	-118° 9.875'		Moon Set	8:50 PM
Elevation	313 Feet		Last New Moon	27-Sep-00

* For Measurements of Sky Luminance

** Clear, Somewhat Cloudy, Partly Cloudy, Very Cloudy, Overcast

*** Few, Moderate, Dense

Table 5: **Direct Sky Luminance Measurements.**

Altitude Angle	Compass Direction								Row Mean	R[redacted] Std. Dev.
	N (0°)	NE (45°)	E (90°)	SE (135°)	S (180°)	SW (225°)	W (270°)	NW (315°)		
15°	0.188	0.144	0.109	0.097	0.137	0.167	0.140	0.179	0.188	0.032
30°	0.078	0.061	0.050	0.049	0.062	0.070	0.069	0.075	0.078	0.011
45°	0.044	0.034	0.030	0.030	0.035	0.040	0.042	0.041	0.044	0.005
60°	0.029	0.024	0.024	0.024	0.025	0.025	0.029	0.028	0.029	0.002
75°	0.024	0.021	0.021	0.020	0.021	0.021	0.022	0.023	0.024	0.001
90° (zenith)	0.021	0.021	0.021	0.020	0.020	0.020	0.020	0.021	0.021	0.001
Column Mean	0.064	0.051	0.043	0.040	0.050	0.057	0.054	0.061	[redacted]	Grand Std. Dev
Column Std. Dev.	0.064	0.048	0.034	0.030	0.045	0.057	0.046	0.061	Grand Mean	0.046

Units: cd/m^2

General Comments & Observations: Stars are clearly visible. There is still some haze, but less than earlier in the evening and the sky is clearer. North is the McDonnell Douglas airport yard. Southwest is toward the harbor.

Nighttime Sky Luminance Survey Form

FIVE

General Information and Purpose for Survey: Evaluation of Urban Sky Glow in the region around the Vincent Thomas Bridge in Long Beach, CA. This set-up is at the Bolsa Chica Wetlands at PCH and Warner.

Table 1: **Client Contact Information.**

Organization:	**Lighting Design Alliance**
Contact Name:	**Chip Israel / Julie Reeves**
Address:	**1234 East Burnett Street**
	Long Beach, CA 90806
Phone:	**(562) 989-3843**
Fax:	**(562) 989-3847**
Email:	

Table 2: **Surveyor Contact Information.**

Organization:	
Survey by:	**Kevin Houser**
Address	**1302 N. 112 CT, #5907**
	Omaha, NE 68154
Phone	**(402) 554-3858**
Fax:	**(402) 554-2309**
Email:	**khouser@unl.edu**

Table 3: **Instruments.**

Measurement	Manufacturer	Model Name	Published Accuracy
Luminance	**Minolta**	**LS-100, 1° spot (SN 78913010)**	**± 2%, ± 2 digits**
Altitude Angle	**Brunton**	**Clino Master (SN 943551)**	**± 1°, ± 2%**
Compass Direction	**Brunton**	**Sight Master (SN 742011)**	**± 1/2° to Magentic North**
Geographic Location	**Garmin**	**Etrex GPS**	**15 meters (49 ft)**
Elevation (relative to sea level)	**Garmin**	**Etrex GPS**	**15 meters (49 ft)**
Temperature	**RadioShack**	**Digital Thermo-Hygro**	**2° F**
Relative Humidity	**RadioShack**	**Digital Thermo-Hygro**	**± 5% RH 40% to 80%**
Tripod Head	**Bogen**	**Junior Geared Head (Model 3275)**	**N/A**
Tripod Body	**ProMaster**	**Model 6600**	**N/A**

Table 4: **General Site Conditions and Information.**

Date	**1-Oct-00 (Sunday)**		Twilight (Astronomical)	**5:24 AM**
Time*	**Start: 10:05 PM**	**End: 10:33 PM**	Twilight	**6:22 AM**
Cloud Cover**	**S: Clear, Light Haze**	**E: Clear, Light Haze**	Sun Rise	**6:47 AM**
Particulates***	**S: Moderate**	**E: Moderate**	Sun Set	**6:37 PM**
Temperature	**S: 70° F**	**E: 70° F**	Twilight	**7:02 PM**
Relative Humidity	**S: 40%**	**E: 40%**	Twilight (Astronomical)	**8:00 PM**
Latitude	**33° 42.649'**		Moon Rise	**10:38 AM**
Longitude	**-118° 3.622'**		Moon Set	**9:27 PM**
Elevation	**0 Feet**		Last New Moon	**27-Sep-00**

* For Measurements of Sky Luminance

** Clear, Somewhat Cloudy, Partly Cloudy, Very Cloudy, Overcast

*** Few, Moderate, Dense

FIVE

Table 5: **Direct Sky Luminance Measurements.**

Altitude Angle	Compass Direction								Row Mean	Row Std. Dev.
	N (0°)	NE (45°)	E (90°)	SE (135°)	S (180°)	SW (225°)	W (270°)	NW (315°)		
15°	0.044	0.065	0.031	0.014	0.007	0.010	0.043	0.046	0.044	0.021
30°	0.021	0.025	0.016	0.009	0.007	0.009	0.019	0.022	0.021	0.007
45°	0.012	0.013	0.010	0.009	0.006	0.008	0.011	0.012	0.012	0.002
60°	0.009	0.009	0.008	0.006	0.006	0.007	0.007	0.009	0.009	0.001
75°	0.007	0.007	0.007	0.006	0.006	0.006	0.007	0.007	0.007	0.001
90° (zenith)	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.000
Column Mean	0.017	0.021	0.013	0.008	0.006	0.008	0.016	0.017	0.013	Grand Std. Dev.
Column Std. Dev.	0.015	0.023	0.010	0.003	0.001	0.002	0.014	0.015	Grand Mean	0.013

Units: cd/m^2

General Comments & Observations: Clear sky with uniform light haze. Many stars are visible. Dark environment with single floodlight to the southwest. Tall HPS roadway lighting along the beach to the south. Northeast reading was probably affected by the lighting for Warner Street. Toward southwest and southeast could pick up PCH/Beach street lighting. South is toward ocean.

Nighttime Sky Luminance Survey Form

SIX

General Information and Purpose for Survey: Evaluation of Urban Sky Glow in the region around the Vincent Thomas Bridge in Long Beach, CA. This set-up is at the top of Signal Hill.

Table 1: **Client Contact Information.**

Organization:	Lighting Design Alliance
Contact Name:	Chip Israel / Julie Reeves
Address:	1234 East Burnett Street
	Long Beach, CA 90806
Phone:	(562) 989-3843
Fax:	(562) 989-3847
Email:	

Table 2: **Surveyor Contact Information.**

Organization:	
Survey by:	Kevin Houser
Address	1302 N. 112 CT, #5907
	Omaha, NE 68154
Phone	(402) 554-3858
Fax:	(402) 554-2309
Email:	khouser@unl.edu

Table 3: **Instruments.**

Measurement	Manufacturer	Model Name	Published Accuracy
Luminance	Minolta	LS-100, 1° spot (SN 78913010)	± 2%, ± 2 digits
Altitude Angle	Brunton	Clino Master (SN 943551)	± 1°, ± 2%
Compass Direction	Brunton	Sight Master (SN 742011)	± 1/2° to Magentic North
Geographic Location	Garmin	Etrex GPS	15 meters (49 ft)
Elevation (relative to sea level)	Garmin	Etrex GPS	15 meters (49 ft)
Temperature	RadioShack	Digital Thermo-Hygro	2° F
Relative Humidity	RadioShack	Digital Thermo-Hygro	± 5% RH 40% to 80%
Tripod Head	Bogen	Junior Geared Head (Model 3275)	N/A
Tripod Body	ProMaster	Model 6600	N/A

Table 4: **General Site Conditions and Information.**

Date	1-Oct-00 (Sunday)		Twilight (Astronomical)	5:24 AM
Time*	Start: 11:05 PM	End: 11:30 PM	Twilight	6:22 AM
Cloud Cover**	S: Clear, Light Haze	E: Clear, Light Haze	Sun Rise	6:47 AM
Particulates***	S: Moderate	E: Moderate	Sun Set	6:37 PM
Temperature	S: 61° F	E: 61° F	Twilight	7:02 PM
Relative Humidity	S: 40%	E: 40%	Twilight (Astronomical)	8:00 PM
Latitude	33° 47.954'		Moon Rise	10:38 AM
Longitude	-118° 9.861'		Moon Set	9:27 PM
Elevation	319 Feet		Last New Moon	27-Sep-00

* For Measurements of Sky Luminance

** Clear, Somewhat Cloudy, Partly Cloudy, Very Cloudy, Overcast

*** Few, Moderate, Dense

SIX

Table 5: **Direct Sky Luminance Measurements.**

Altitude Angle	Compass Direction								Row Mean	Row Std. Dev.
	N (0°)	NE (45°)	E (90°)	SE (135°)	S (180°)	SW (225°)	W (270°)	NW (315°)		
15°	0.149	0.138	0.091	0.079	0.100	0.123	0.112	0.153	0.149	0.027
30°	0.057	0.047	0.042	0.038	0.046	0.051	0.050	0.051	0.057	0.006
45°	0.030	0.027	0.024	0.023	0.026	0.028	0.029	0.029	0.030	0.003
60°	0.021	0.019	0.019	0.018	0.019	0.019	0.021	0.020	0.021	0.001
75°	0.018	0.017	0.016	0.015	0.017	0.016	0.017	0.016	0.018	0.001
90° (zenith)	0.016	0.016	0.016	0.015	0.015	0.015	0.016	0.015	0.016	0.001
Column Mean	0.049	0.044	0.035	0.031	0.037	0.042	0.041	0.047	0.041 Grand Mean	Grand Std. Dev.
Column Std. Dev.	0.051	0.047	0.029	0.025	0.033	0.042	0.037	0.053		0.038

Units: cd/m^2

General Comments & Observations: Clear sky with uniform light haze – somewhat less than last night. May have been able to pick up adjacent street lighting northwest. Skytrackers from Landmark building are just barely visible.

Nighttime Sky Luminance Survey Form

SEVEN

General Information and Purpose for Survey: Evaluation of Urban Sky Glow in the region around the Vincent Thomas Bridge in Long Beach, CA. This set-up is near the Queensway Bay lighthouse.

Table 1: **Client Contact Information.**

Organization:	Lighting Design Alliance
Contact Name:	Chip Israel / Julie Reeves
Address:	1234 East Burnett Street
	Long Beach, CA 90806
Phone:	(562) 989-3843
Fax:	(562) 989-3847
Email:	

Table 2: **Surveyor Contact Information.**

Organization:	
Survey by:	Kevin Houser
Address	1302 N. 112 CT, #5907
	Omaha, NE 68154
Phone	(402) 554-3858
Fax:	(402) 554-2309
Email:	khouser@unl.edu

Table 3: **Instruments.**

Measurement	Manufacturer	Model Name	Published Accuracy
Luminance	Minolta	LS-100, 1° spot (SN 78913010)	± 2%, ± 2 digits
Altitude Angle	Brunton	Clino Master (SN 943551)	± 1°, ± 2%
Compass Direction	Brunton	Sight Master (SN 742011)	± 1/2° to Magentic North
Geographic Location	Garmin	Etrex GPS	15 meters (49 ft)
Elevation (relative to sea level)	Garmin	Etrex GPS	15 meters (49 ft)
Temperature	RadioShack	Digital Thermo-Hygro	2° F
Relative Humidity	RadioShack	Digital Thermo-Hygro	± 5% RH 40% to 80%
Tripod Head	Bogen	Junior Geared Head (Model 3275)	N/A
Tripod Body	ProMaster	Model 6600	N/A

Table 4: **General Site Conditions and Information.**

Date	1-Oct-00 (Sunday)		Twilight (Astronomical)	5:24 AM
Time*	Start: 11:50 PM	End: 12:25 PM	Twilight	6:22 AM
Cloud Cover**	S: Clear, Light Haze	E: Clear, Light Haze	Sun Rise	6:47 AM
Particulates***	S: Moderate	E: Moderate	Sun Set	6:37 PM
Temperature	S: 61° F	E: 61° F	Twilight	7:02 PM
Relative Humidity	S: 40%	E: 40%	Twilight (Astronomical)	8:00 PM
Latitude	33° 45.610'		Moon Rise	10:38 AM
Longitude	-118° 11.730'		Moon Set	9:27 PM
Elevation	29 Feet		Last New Moon	27-Sep-00

* For Measurements of Sky Luminance

** Clear, Somewhat Cloudy, Partly Cloudy, Very Cloudy, Overcast

*** Few, Moderate, Dense

SEVEN

Table 5: **Direct Sky Luminance Measurements.**

Altitude Angle	Compass Direction								Row Mean	Row Std. Dev.
	N (0°)	NE (45°)	E (90°)	SE (135°)	S (180°)	SW (225°)	W (270°)	NW (315°)		
15°	0.221	0.138	0.078	0.190	0.536	0.514	0.355	0.267	0.221	0.168
30°	0.088	0.068	0.049	0.107	0.214	0.190	0.186	0.129	0.088	0.062
45°	0.045	0.040	0.034	0.052	0.105	0.099	0.078	0.073	0.045	0.027
60°	0.030	0.030	0.030	0.035	0.057	0.068	0.056	0.049	0.030	0.015
75°	0.024	0.026	0.027	0.029	0.037	0.050	0.040	0.039	0.024	0.009
90° (zenith)	0.024	0.027	0.028	0.030	0.036	0.038	0.035	0.033	0.024	0.005
Column Mean	0.072	0.055	0.041	0.074	0.164	0.160	0.125	0.098	0.099 Grand Mean	Grand Std. Dev. 0.115
Column Std. Dev.	0.077	0.044	0.020	0.064	0.194	0.182	0.126	0.090		

Units: cd/m^2

General Comments & Observations: Clear with a uniform light haze. Fewer stars visible than earlier in the night (e.g. measurements five and six). Long Beach is to the north. Long Beach Harbor is to the south. Queen Mary to the southeast, blue bridge to the west. Three small clouds were to the west about halfway through taking measurements. Began to clear to the east during the course of measurements.

NW measurement at 15° (altitude) was adjusted 5° degrees toward north because a tree was in the way.

Following are brief descriptions of additional contacts/meetings that we have been involved with throughout the past year in regards to understanding the issues and finding a solution:

- Patrick Wells
  Trizekhan
  Security Officer at The Landmark Building
  562.495.5000
  9/7/00

LDA spoke with Patrick regarding the upkeep of the building and inquired as to how many bird fatalities that he could estimate that he had observed in the last five years. In his daily walk of the building, including the roof, and he has never noticed any bird fatalities. Interestingly enough, he stated that during the day he has noticed birds perched ON the 7000kW xenon lights at the top of the building when they are turned off.

- Mr. Michael Mesure
  9 March 2000
  Fatal Light Awareness Program (FLAP)
  Recommended contact by the local wildlife associations

See attached notes from lengthy phone conversation.

- Nancy Clanton
  Clanton Engineering
  Boulder, Colorado

Nancy is a well know lighting expert in environmental lighting solutions and "Green" lighting. She also is actively involved with the International Dark Sky Association. We have spoken with her on two or three occasions throughout the year and have implemented all of her suggestions as to mitigating and dark sky concerns. She directed us to create a design that minimized the spill of light and if there were possibilities of spill, to create some sort of "sponge" to absorb the light. This sponge has been applied in the form of the half sphere at the top of the towers that cantilevers over the edge to catch any spill light from the few lights aimed upward. Nancy also suggested community "trade offs" with other light sources in the area. The surrounding street lighting and spill light in and around San Pedro could be re-directed and/or eliminated in order to create a net glow gain of zero.

- Dr. Kevin Houser, PhD., LC
  University of Nebraska
  College of Engineering and Technology

Dr. Houser was brought out to Los Angeles to do a study on the current sky glow conditions at the Port of LA as well as comparison studies in the Los Angeles area in an effort to illustrate the lack of impact that the new lighting will have on the light levels in the port. This study will also illustrate how birds will not be confused by a newly lit structure when such high ambient light levels surround it.

- IALD Members Worldwide (over 500 contacted via e-mail)

The International Association of Lighting Designers consists of a wide range of lighting designers, most of who have delt with the lighting of major structures, many bridges included. We sent out a mass e-mail asking for feedback as to who, if anyone, had encountered problems and had found viable solutions to environmental concerns when it came to lighting tall structures. After hearing back from over 40 of them we have not heard of any projects that had been shut down due to these impacts and all who had suggestions offered the same solutions that we are suggesting with the latest re-design. Most were not aware that the bird strike issue was there and are further learning from our attention and solutions to the matter.

- Frank Ledesna
  Head of Electrical Engineering at Coronado Bridge in San Diego – In the Coastal Fly
  Zone.

There is no decorative lighting on the Coronado bridge though Mr. Ledesna described the functional lighting on the bridge as to have no known affect on birds.

Others that have been interviewed and consulted:

Dr. Charles T. Collins
Department of Biological Sciences
California State University, Long Beach

Bob Mizon
Astronomical Society

Dr. Christopher Baddiley
Astronomical Expert

COPY

United States Department of the Interior
Fish and Wildlife Service
Ecological Services
Carlsbad Fish and Wildlife Office
2730 Loker Avenue West
Carlsbad, California 92008

Roella H. Louie
Cultural Grants/Arts Manager
City of Los Angeles
Cultural Affairs Department
433 S. Spring St. 10 th Floor
Los Angeles, California 90013

Re: Redesign of Vincent Thomas Bridge Lighting Project, City of Los Angeles, Los Angeles County, California

Dear Mr. Price:

We have reviewed the *Vincent Thomas Bridge Lighting Design* (Lighting Design Alliance, September 2000), which we received on September 18, 2000. This new design was submitted in response, in part, to concerns we raised in our letter of October 25, 1999, regarding the impact of the lighting project to migratory birds. The project concerns your proposed lighting of the Vincent Thomas Bridge in San Pedro, City of Los Angeles, Los Angeles County, California.

The new design significantly reduces the amount of light emitted, which should minimize the effects on migratory birds. The Xenon searchlights, originally proposed for the tops of the towers, have been removed in the new proposal. These lights were our primary concern because of their brilliance and unshielded, upward orientation. Moreover, the number of floodlights has been reduced and remaining floodlights will be shielded. Finally, the other remaining lights have been reduced in number and brilliance.

Significant control changes are proposed that, if implemented, should further minimize the effects of the lighting project on migratory birds. Under the new design, the bridge lights will be turned off for multiple months of the year during spring and fall migration. We are available to assist in defining the key migratory periods for birds. Moreover, the lights will be turned off during any overcast, cloudy, or otherwise hazy environmental conditions, which is important because many of the documented mass mortalities associated with lighted towers occurred during such conditions. In addition, lighting will be limited to approximately 4 to 5 hours per night during the darkest time of the night depending upon the time of year. We recommend that these controls to minimize the effects on birds be maintained for the life of the project.

According to the new design, the lighting project will be studied to determine the effects of such a project on migratory birds in this coastal zone. We would greatly appreciate receiving information on the identity of the researchers, and the objectives and design of this study.

In conclusion, we concur with the design and control changes now proposed for the Vincent Thomas Bridge lighting project. We appreciate the significant changes made in the lighting design to minimize potential impacts to migratory birds, and thank you for the opportunity to comment on the new design. If you have any questions regarding the information in this letter, please contact David Zoutendyk of my staff at (760) 431-9440.

Sincerely,

Jim A. Bartel
Assistant Field Supervisor

1-6-2001-1051

cc: Brad Bortner (Division of Migratory Birds and Habitat Programs, Portland, OR)
Bob Trost (Office of Migratory Bird Management, Portland, OR)
Larry Farrington (Division of Law Enforcement, Torrence, CA)
Al Padilla (California Coastal Commission, Long Beach, CA)
Karl Price (Caltrans, Los Angeles, CA)
Bill Tippets (CDFG, San Diego)
David Kessler (FAA, Los Angeles)
Jeff Geupel (Point Reyes Bird Observatory, Stinson Beach)
Pacific Flyway Council
Eric Moses (Mayor's Office, City of Los Angeles)

Long Beach

ROOM 3086
STATE CAPITOL
SACRAMENTO, CA 95814-4906
(916) 445-6447
FAX (916) 327-9113

111 LONG BEACH BOULEVARD
SUITE 801
LONG BEACH, CA 90807
(562) 997-0794
FAX (562) 997-0799

California State Senate

BETTY KARNETTE
SENATOR
TWENTY-SEVENTH DISTRICT

COMMITTEES:
CHAIR
TRANSPORTATION
MEMBER
APPROPRIATIONS
FINANCE, INVESTMENT AND INTERNATIONAL TRADE
GOVERNMENTAL ORGANIZATION
INDUSTRIAL RELATIONS
PUBLIC EMPLOYMENT AND RETIREMENT
SELECT COMMITTEE
ALAMEDA CORRIDOR (CHAIR)
JOINT COMMITTEE
FISHERIES AND AQUACULTURE

October 17, 2000

Ms. Sara Wan, Chair
California Coastal Commission
45 Fremont Street, Suite 2000
San Francisco, CA 94105

Dear Commissioner Wan:

I am writing to express my continuing, strong support for the lighting of the Vincent Thomas Bridge.

The application for this project, submitted by the California Department of Transportation, will be considered at the California Coastal Commission (CCC) meeting scheduled for November 2000.

As you know, the CCC voted against a proposal to illuminate the Vincent Thomas Bridge in November 1999. In making this decision, the CCC cited several reasons, including the affect on migratory birds as well as issues related to increased light in the Harbor's sky.

After meeting with members of the environmental community in the San Pedro area, the Lighting Design Alliance has redesigned its previous proposal to address and alleviate the concerns surrounding this worthwhile and important project.

I fully support the Lighting Design Alliances modified lighting plan. You will find that the Lighting Design Alliance has made significant efforts and amended its plans to satisfy environmental concerns. For this reason, I respectfully request your support of the amended plan.

Please feel free to contact me at (562) 997.0794 if you have any questions. Thank you for your attention to this request.

Sincerely,

Betty Karnette

BETTY KARNETTE

BK:kj

Cc: Assemblyman Alan Lowenthal
Councilman Rudy Svorinich, Jr.
Mr. Peter Douglas, Executive Director, California Coastal Commission

EXHIBIT NO. 14
APPLICATION NO.
5-00-384
Letter in Support
Senator Karnette
California Coastal Commission

City of Los Angeles

LOS ANGELES, CALIFORNIA 90012
(213) 847-2489

OFFICE OF THE MAYOR

RICHARD J. RIORDAN
MAYOR

September 28, 2000

Al Padilla
California Coastal Commission
Analyst
South Coast District
200 Oceangate, Suite 1000
Long Beach, CA 90802

Dear Mr. Padilla:

On behalf of the City of Los Angeles, we urge you to support the artistic architectural lighting of the Vincent Thomas Bridge, which serves as the City's Welcoming Monument at the Port of Los Angeles.

The City's application, which was submitted by the California Department of Transportation, because it has jurisdiction over the bridge, will be considered at the Coastal Commission's November 2000 meeting in Los Angeles.

In November 1999, your commission rejected an earlier request for a variety of reasons, including the potential harm to migratory birds and the additional light to the night sky above the Los Angeles Harbor. After reviewing the transcript of that hearing, as well as meeting with environmental and dark sky advocates, Lighting Design Alliance crafted a thoughtful redesign that sufficiently addresses the articulated concerns. To this end, not only is the new design better for the environment, it also uses considerably less energy and provides the City with a much stronger artistic design that is tasteful, sleek and unique.

The lighting of the Vincent Thomas Bridge is an important project for the City of Los Angeles and those who live and work in the Los Angeles Harbor area. The bridge itself is a source of civic pride for residents, many of whom have invested sweat and pennies for more than a decade to raise money for the lighting project.

To help better understand the project's significance, you are cordially invited to visit the Port of Los Angeles for a tour of its facilities, where this majestic Vincent Thomas Bridge is located. Please call Eric Moses of the Mayor's staff (213/847-3574) if you have any questions and to facilitate the tour that will accommodate your very busy schedule.

We look forward to hearing from you at your earliest convenience.

Sincerely,

RICHARD J. RIORDAN
Mayor

RUDY SVORINICH, JR.
Assistant President Pro Tempore Councilman,
15th District

cc: Senator Betty Karnette
Assemblyman Alan Lowenthal
Larry Keller, Executive Director, Port of Los Angeles
Al Nodal, General Manager, Cultural Affairs Department
Robert W. Sassaman, District 7 Director, California Department of Transportation

B. SZABO, INC.
BARNA S. SZABO
PRESIDENT

October 2, 2000

Ms. Sara Wan Commission Chair
C/o Mr. Al Padilla
California Coastal Commission
South Coast District
200 Oceangate, Suite 1000
Long Beach, CA 90802

Re: Vincent Thomas Bridge Lighting Project

Dear Commissioner Wan:

I would like to add my support for the **Vincent Thomas Bridge Lighting Project**. My work takes me to a number of locations and businesses in the harbor area where I am finding a general consensus in support of this worthwhile project. Many of us who work or live in the area are trying our best to make the harbor not just a place of work but also an exiting place to visit. This Project would be a creative and delightful addition to the overall atmosphere of the community and a welcoming attraction for people who come to visit this great harbor!

I urge you to vote for approval of the proposed project. Thank you.

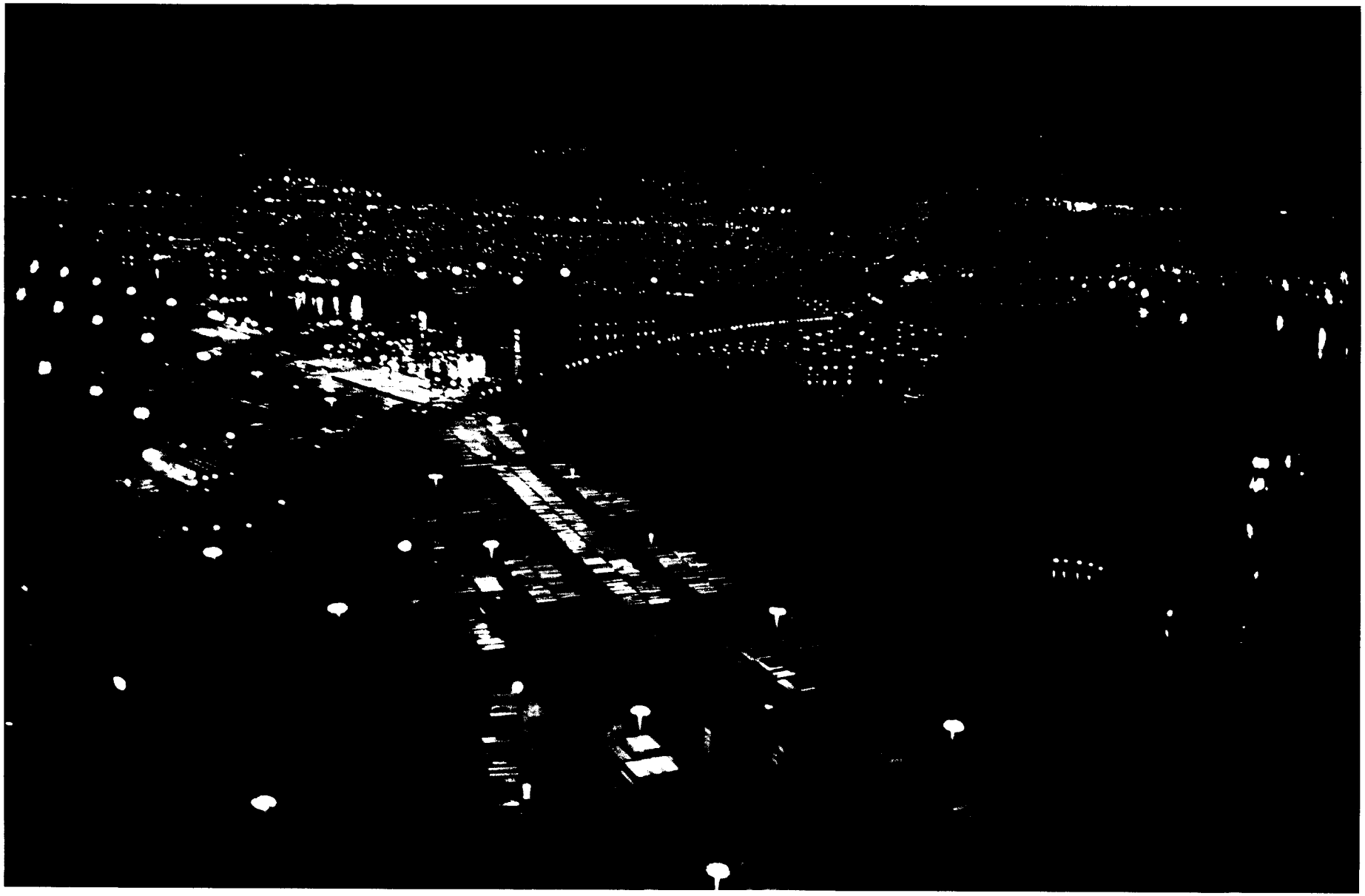
Sincerely yours,

Barna Szabo

Barna Szabo

11835 West Olympic Blvd., Suite 645, Los Angeles, CA 90064
Telephone (310) 478-5075 FAX (310) 479-6508
E-Mail: bszaboinc@aol.com

Exhibit # 172
S-CC-384



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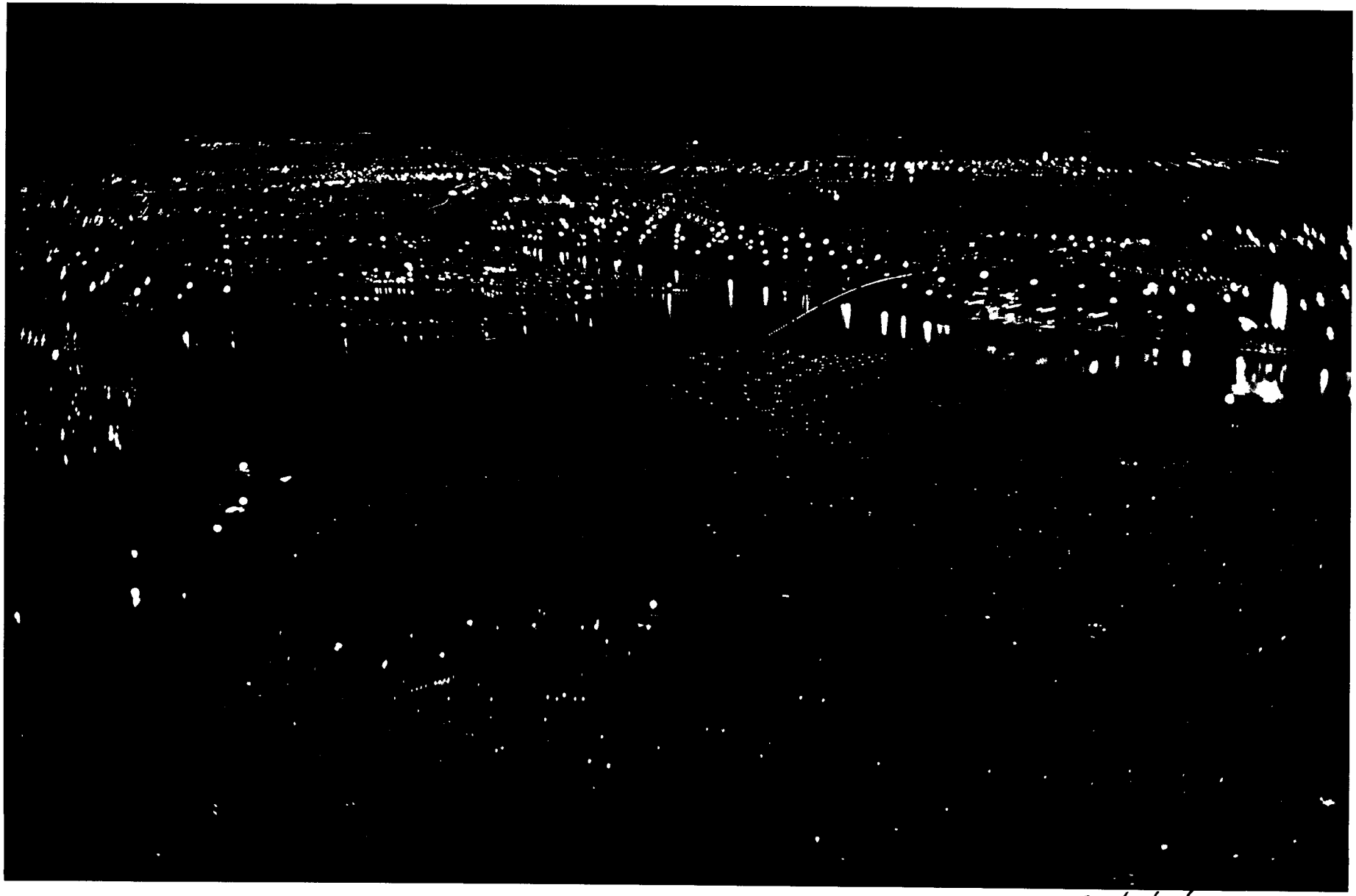
5-00-384



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