CITY OF OAKLAND

# AGENDA REPORT

**TO:** DEANNA J. SANTANA
CITY ADMINISTRATOR

**FROM:** Ahsan Baig

**SUBJECT:** RCC's Side-by-Side Analysis of Oakland and EBRCS P25 Radio Systems

**DATE:** November 22, 2013

City Administrator Approval Deanna Date 12-5-13

## RECOMMENDATION

(a) Informafional Report on RCC's side-by-side analysis of Oakland and EBRCS P25 Radio Systems,
(b) Council action authorizing the City Administrator to enter into negotiations with EBRCS and retum to Council in 90-120 days with proposed negotiations terms and a funding and transition plan for the City Council to consider, conditioned upon the successful outcome of negotiated terms.

## OUTCOME

The City receives a detailed side-by-side analysis of the Oakland and EBRCS Radio systems and makes determinations on next steps relative to the findings of this report. In summary, the RCC supplemental report finds that the two radio systems are fairly similar in coverage, performance, and reliability, while emphasizing that the City Microwave Network remains a valuable City asset that should remain in place regardless of the future direction the radio system takes.

## EXECUTIVE SUMMARY:

Since inception of this project, the City has been undergoing several efforts to stabilize the City's P25 radio system and remedy several performance attributes. Over the past year, in addition to stabilizing our system, the City has been engaged in working with subject matter experts toward completing an analysis of the two systems to determine whether there is benefit to recommending that the City transfer to the EBRCS P25 radio system. The results of this effort can be found in the attached Consultant's report and the purpose of this report is to present the findings of the independent Consultant's report with preliminary staff analysis.

The side-by-side analysis of the EBRCS P25 radio system and the City's current P25 radio system was performed by RCC Consultants, based on a Statement of Work and Project Plan developed in collaboration with all key stakeholders, including, the Oakland Police Department, Oakland Fire Department, Compliance Director's Office, Oakland Police Officers Association, Department of Information Technology, and the East Bay Regional Communications Systems Authority (EBRCSA). The report compares the two systems based on various key aspects; namely, coverage, performance, cost, maintenance, sustainability, governance, reliability and

capacity. In addition to the comparative analysis, RCC also performed preliminary engineering analysis of the Fire Station 25 monopole replacement.

The Consultant finds that the problems that plagued the Oakland P25 System have been addressed to a significant extent, and have resulted in measurable improvements in both the real and perceived performance of the Oakland P25 system. This finding is demonstrated by the responses of Police and Fire staff members that took part in the analysis, along with the testing of the data by comparing both systems.

The Consultant's fiscal analysis suggests that joining EBRCS would cost the City less in the short-term, but more in the long-term (in the neighborhood of $25M over a period of five years, not including any of the soft costs) based on higher EBRCS annual expenses. This initial cost savings is based on the Consultant's premise that if the City joins EBRCS, it would eliminate the need to make further investments into identified P25 System upgrades and eliminate the need to further invest in intemal staff resources and should instead, consider contracting out the operations and maintenance of the subscriber radio fleet.

Specifically, the Consultant's report states *"A concern with the current radio system is that while the taskforce has solved the problems with the interference and system performance, the City still needs to make a similar investment in hiring, training, and equipping radio shop personnel. The City needs to either commit to moving forward with Radio Shop improvements, or outsource these services entirely by joining EBRCS, hiring an outside agency to maintain the fleet of user radios, and in RCC's perspective get out of the radio business."*

The Consultant points out that based on the current govemance model and number of users, a fair and equitable representation for the City on the JPA Board would be equivalent to four standing seats. Staff agrees with the Consultant that this is an issue of considerable concem and the City would be at risk of having no influence or ability to control its own radio needs or future budgeted costs with one sole vote on a system where it represents a significant portion of the EBRCS system.

The report identifies four critical needs that, in some cases, are required regardless of which system the City uses for P25 radios:

1) Immediate need to secure a services contract for the maintenance of the City's existing subscriber radio fleet,
2) Replace the current aging radio fleet,
3) Investment in additional personnel resources for maintenance, training and operational related equipment, and
4) Additional investment into previously identified infrastructure upgrades which support public safety communications.

## BACKGROUND/LEGISLATIVE HISTORY

The City implemented several improvements to its P25 radio system years ago that were inadequately planned for, communicated, and, more importantly, resourced. This revealed the need for further improvements to immediately stabilize the system and surfaced several legacy practices that illustrated the inadequacies that plague the system performance, e.g., maintenance, training, lack of investment/resources, etc. As such, staff presented an analysis matrix in June 2013 that guides the areas that needed to be evaluated to resolve further improvement areas and achieve a side-by-side analysis of the two systems to determine if transferring from the Oakland P25 to the EBRCS system is in the best interest of the City's present and future radio needs.

At the Finance & Management Committee on June 25, 2013, the Committee directed staff to negotiate a professional services contract with RCC Consultants, Inc. to provide an independent side-by-side comparison of the EBRCS P-25 Radio System and the Oakland P25 Radio System, as well as providing an addendum to their report dated March 2012.

In addition, the Committee directed staff to include an examination of relocating the City Microwave Network into various EBRCS facilities while also examining the redesign of the network to include the relocation of the GWIN and Fire Station 25 Radio Sites by utilizing additional EBRCS facilities located at Skyline Blyd and UC Berkeley.

On July 30, 2013, City Council passed the Resolufion 84573 C.M.S. and directed Staff to complete the side-by-side report no later than November 1, 2013, and subsequently schedule the findings for a City Council review. As referenced in an issued Informational Memo, the Consultant has been delayed in completing this complex review.

## ANALYSIS

The side-by-side analysis began in August of 2012 with staff beginning the technical review of designs and drawings provided by EBRCS. This technical review continued late last year with City contracting a Consultant to conduct In-Building coverage tests to compare coverage between both respective systems. These tests resulted in the City's receipt of EBRCS programmed radios in February 2013 to begin the field analysis of whether the City should transfer to the EBRCS system. As this effort continued, several discussions took place that resulted in the formation of a Technical Project Committee that was inclusive of all intemal and extemal stakeholders. This Committee included representatives from the Oakland Police Department, Compliance Director's Office, Oakland Police Officers Association (as we understand, Local 55 was invited but it delegated its interest to OPOA), Oakland Fire Department, Oakland Department of Information Technology, and the Executive Director of EBRCS.

This Committee kicked off the project on July 15th by holding its first meeting with all stakeholders to outline the purpose of the project and a discussion with RCC related to the scope of their analysis. Regular progress meetings were held and included discussions concerning timelines, technical testing criteria, and eventually the dissemination of draft results.

A. Project Collaboration

It is important to note that the role of the City Project Manager for this analysis was limited to coordination of meetings and to act as a liaison for RCC to collect and provide internal information as requested. Because much of the information being collected by the Consultants from users and stakeholders would be subjective in nature, in order to ensure this analysis project remained unbiased, the Department of Information Technology wanted to foster an environment where the collected feedback would be as honest and "un-censored" as possible. Therefore, the City Project Manager did not participate in any of the individual stakeholder interview sessions or the technical testing sessions conducted by the Consultant. In summary, while staff members from the Department of Information Technology did manage this project, it did so with a "hands-off' and transparent approach to ensure there could not be a perception of interference, or skewing of technical results. The project was conducted with absolute transparency and positive collaboration with all of the effected stakeholders.

In fact, at the City Administrator's direction, all stakeholders met at the same time to receive an oral presentation of the Consultant's preliminary findings and, later, received the draft written report immediately upon issuance. Further, at the meeting where the oral presentation was made, the stakeholders agreed to the timeframe to review and provide edits and our desire to provide presentations in two parts, given its complexity. This was done to ensure equity of receipt of information and to ensure maximum transparency with respect to the findings and methodologies used to achieve these findings.

B. Drive Test Results

Comparative tests to assess the coverage and performance characteristics of both P25 Systems were performed in September 2013. The testing procedure and plan was developed in collaboration with EBRCS with a final Test Plan presented for approval to the Technical Project Committee in late August. The testing involved automated test collection of over 34,000 test points within the City coverage area. The tests included a collection of signal level to determine radio coverage, sample audio transmissions to demonstrate radio functionality and audio quality within the coverage area, and the collection of Bit-Error Rate (BER) to determine signal quality within the coverage area.

Staff has reviewed the Consultant's report and the test data pertaining to the performance drive tests and agrees with its findings. As a result of the proactive maintenance and regular system monitoring performed on the system over the course of last year, the Oakland P25 System is performing at, or exceeding a level expected of a public safety radio system. In addition, we agree with the Consultant's recommendation that the City's portable radio fleet is in need of replacement due to age and previously deferred maintenance, and acknowledges that the on-going field based complaints regarding radio performance are directly related to the current condition of the subscriber radio equipment.

With respect to the field tests section related to Bit-Error Rate (BER), and the quality measurements of both systems, staff has reviewed the data conceming the Oakland P25 System and is using it to continue to identify and mitigate additional sources of interference. Staff recognizes that the Bit-Error-Rate results presented by the Consultant are not representative of "dead spots" or a lack of quality in either system since the outdoor wireless environment is a constantly changing landscape that involves many variables that do change from moment to moment. As Oakland is a population dense area with unique topography that includes hills, valleys, waterways, and a high-rise concentrated urban center making it extremely complicated from a wireless environment perspective.

In reviewing the data conceming the EBRCS system, staff agrees that the frequency band utilized by EBRCS system is likely subject to higher BER percentages given the proliferation of 4G Long Term Evolution (LTE) smartphones operating in adjacent 700 MHz spectmm. Staff does not believe the test results for EBRCS present any widespread user problems today, but rather validates that the City's effort to locate and mitigate interference in the 850 MHz frequency band have been successful. This interference had been a significant contributor to the problems experienced by the City.

Staff agrees with the Consultant that in either scenario, the City and EBRCS must remain vigilant to protect the wireless environment that supports public safety communications. Staff has expressed the need to be able to continue to protect the wireless spectmm utilized by the City's first responders, should it decide to transition to EBRCS. EBRCS should provide assurances that an ongoing mitigation plan or additional testing exists to address any concerns relative to interference.

C. Radio Compatibility Test Results

The second set of tests performed by the Consultant was related to radio equipment compatibility, specifically, the ability for the City to reuse its existing radio fleet on the EBRCS system. During these tests, it was noted that some operational features of the City's existing radio fleet did not perform as expected and many other important features related to network reliability testing were unable to be fully tested since the EBRCS system is now a live system.

Overall, the Consultant continued to reiterate that even if these features could pass these tests, or if other operational changes were made to adapt our users to the abnormal conditions, if the City joins EBRCS, that the City should begin to migrate to a new radio fleet as part of any plan moving forward. In fact, regardless of which radio system the City elects to participate in, the City is in need of replacing the inventory of radios given the fact that they are at the end, or past, of their useful life.

Staff agrees with the Consultant's recommendation to replace the radio fleet; however, we disagree that such a transition should occur over time through attrition. Staff believes that the radio fleet should be fully transitioned to ensure compatible equipment given our operational and maintenance considerations that are detailed further in this report. Since most of the on-going field based complaints regarding radio performance are directly related to the current condition

of the subscriber radio equipment, replacing them through attrition would not resolve the problem quickly.

**D.** Interoperability

The issue of radio interoperability has been a long-standing area of concern expressed by many users of the Oakland P25 System. The City previously operated a proprietary radio system that did not allow for seamless interoperability with outside agencies. Much of the conversation about the need to transition to EBRCS is to ensure our first responders can communicate with outside agencies. While the City has been transitioned to P25 technology for over two years, the rest of the region is now catching up and is finally allowing this new technology to be fully realized, thereby eliminating the need for radio users to operate the same radio system in order for them to communicate with each other.

Recently, the City has taken major steps forward to solve the interoperability concerns. Specifically, staff has been working to provide Mutual-Aid access to extemal enthies that currently have P25 radio equipment. Over the past year, the Oakland P25 System has grown to include Mutual-Aid users from a variety of agencies including, Berkeley Police Department, Berkeley Fire Department, Emeryville Police Department, Emeryville Fire Department, Alameda City Fire Department, Alameda County Fire Department, East Bay Regional Parks Police Department, Califomia Highway Patrol, and is currently working to load additional EBRCS subscribed public safety users onto the Oakland P25 System. In summary, staff is working to ensure that Oakland residents will be well served during a major incident in the event the City calls for Mutual-Aid assistance from neighboring jurisdictions.

In addition, users of the Oakland P25 System are the only first responders that currently possess the capability to operate seamlessly in the underground BART stations and tunnels. This is currently accomplished by radio equipment compatibility with the BART system, and once the BART underground P25 System goes live, Oakland users will transition to utilizing the P25 Inter RF Sub System Interface (ISSI) link that is currently deployed between the Oakland P25 System and the now under-construction BART P25 System. As confirmed by BART personnel, and by the Consultant, EBRCS users do not have the ability to seamlessly communicate once they go underground unless they are equipped with a BART provided radio, or utilize altemative State provided Mutual-Aid channels. This is an important matter to resolve given that BART is well represented in Oakland, significantly more present than in other EBRCS member cities, and the heightened public discussion relative to BART workplace safety.

As noted by the Consultant, the only issue keeping Oakland and EBRCS from achieving the highest levels of interoperability today is an administrative policy decision by EBRCS to disallow Mutual-Aid access to non-member entities. This policy is unprecedented in terms of a public safety radio system provider charging access fees for Mutual-Aid and should be further explored vis-à-vis the above concern relative to representative govemance and the number of Oakland representatives to ensure that future decisions are not made against the City's public safety goals and needs.

At this time, since staff is currently fulfilling requests made by extemal entities to program their radios on the Oakland P25 System for purposes of Mutual-Aid, the limitation of Oakland not having access to EBRCSA for interoperability has a far greater impact to EBRCS subscribing agencies who are not able to communicate when Oakland responds into their jurisdictions when they call for Mutual-Aid assistance. In summary, as the Consultant's report and staff have made clear, the issue surrounding the lack of interoperability between Oakland and EBRCSA is a policy decision by the EBRCS Board, not a technology hurdle that needs to be solved by replacing a radio system.[1]

**E.** Business Case Assessment

The Consultant's report finds that by joining the EBRCS, City will be able to use the regional radio system; however, the City will not be in a position to modify and/or change the system configuration. The overall five years cost projections, provided by RCC, will be higher and will not yield any labor cost savings.

Staff recommends that should the City decide to transition to EBRCS, it should continue to preserve the existing P25 System as a backup system for our first responders, and continue to utilize it to serve our non-public safety users and any extemal entities who currently utilize it for day-to-day operations. This also allows for the City's clients (those jurisdicfions subscribing to the Oakland P25 system can make their own decision on whether to stay with the system or transition to EBRCS within the agreed to service contract term). Additionally, this addresses the Consultant's former report and concems that the City does not have a back-up radio system. The Consultant report idenfified that the costs to continue to operate and maintain the existing P25 System as a backup system, would total approximately $403,000 per year. This cost would largely be offset by subscriber radio contributions from the 4200 Radio Fund. This requires more evaluation before a final decision is made with respect to this recommendation.

The Consultant presents three separate financial plans to describe the various scenarios that are under consideration. Staff has not fully examined these financial plans and recommends that we retum within 90-120 days with analysis and a funding plan. The Consultant estimates are as follows:

- Option A, involves moving all City of Oakland users to EBRCSA. Under this scenario the five-year cost projection is $24,288,500 of which $1,424,400 is the yearly operafing expense.
- Option B, involves continuing to maintain the Oakland P25 System as the primary solution for all City users. Under this scenario the five-year cost projection is $20,016,500 of which $403,000is the yearly operating expense.
- Option C, involves moving public safety users to EBRCSA while continuing to maintain the Oakland P25 System for public works users. Under this scenario the five-year cost projection is $22,222,500 of which $1,316,200 is the yearly operafing expense.

[1] The Board's decision needs to be carefully evaluated with respect to the governance model and the City's need for fair representation regarding its service needs.

It should be noted that none of the above plans include the capital costs related to necessary infrastructure improvements to the Seneca or Owin communication facilities or the Microwave Network reconfiguration.

One option not discussed in the Consultant's report, but worthy of exploring, is the option to subscribe to EBRCS for a lower number of EBRCS radios, very similar to the City of Hayward service delivery model. As staff has explained in past reports, the City of Hayward Police Department is not a full-fledged EBRCS subscriber. The Hayward Police Department operates their own radio system, with plans to continue this business model for the foreseeable future. Subscribing in this manner would allow the City to maintain the Oakland P25 system until such time that the City clearly understands the long-term costs, and operational performance of EBRCS, while closely monitoring how its funding model and budgets continue to evolve given potentially costly technical uncertainties, as called out in the Consultant's report it is facing. The Consultant's report calls attention to large microwave network upgrade and improvement costs that will be necessary for EBRCS to address in the near term, and staff is further aware of additional spectrum related upgrades that EBRCS may be faced with in the long-term. As detailed by the Consultant, the City's system shall not be subject to the same projected costs for upgrades and improvements since the City's Microwave Network is of a newer vintage and, the spectrum operated by the City of Oakland is not subject to the same regulatory upgrades currently facing the EBRCS system.

Subscribing to a lower number of radios would allow the City to begin a relationship with EBRCS while assessing the EBRCS network in the near term, while allowing the City to examine whether this is a viable option for the purpose of functionality and integration into existing systems, while also allowing the City to utilize its existing resources to focus on the most immediate need of replacing the subscriber radio fleet. This option would also provide staff with the opportunity to continue the discussions with EBRCS in areas related to securing financial commitments and fair and equitable governance protections. It is understood that other EBRCS members utilize this service/membership model.

Staff recommends that it should return to Council with additional detailed information concerning the capital and ongoing operational costs that fully capture all three scenarios that should be considered as part of any decision. For this reason, stakeholders discussed a two part report and, given the significant required investment, the need to make fiscal decisions in the context of an unbalanced budget in the Jan/Feb 2013 timeframe, and upon the results of the 2nd Quarter Revenue & Expenditure report (which would include property tax collections and provides a six month revenue scenario of how the City is performing and related expenditures). It should be noted that the need to rebalance the City's budget is due to the acknowledgement that it is unbalanced due to other anticipated expenditures and this presents new significant expenditures that have not been budgeted.

F. Microwave System Assessment

An important component of this analysis was for the Consultant to provide Council with information pertaining to the City's Microwave Network. This request was made to ensure that investments into the City's infrastructure would not be wasted in the event the City were to transition to EBRCS. The Consultant's report described the Microwave Network as a "*significant, underutilized resource for the City of Oakland*" and staff fully agrees with this statement with the caveat that its underutilization is a product of the understaffing and lack of resources the Department of Information Technology currently has available to continue migrating voice and data traffic to this mission critical network. Furthermore, the Consultant has made numerous conclusions that the City may want to consider sharing bandwidth with EBRCS, in order for them to shore up their own un-protected microwave network, and possibly, allow EBRCS to utilize the City Microwave Network as an altemative to their own aging, and now manufacturer discontinued microwave equipment.

The Consultant also examined if the EBRCS site located on Skyline could be used as an altemative to the Fire Station 25 tower. The Consultant presented a redesign scenario to enable the City to remove the Fire Station 25 tower with the caveat that certain design criteria for the Eastmont Substation would need to be met under this scenario. Specifically, it would require the use of a new tower at Eastmont, with a preliminary height of over fifty (50) feet. If this design criterion is met, the Consultant presents an estimated construction cost of $684,000 based on their preliminary engineering estimate. The Consultant did not further examine altematives to the Gwin radio site relocating to an EBRCSA altemative site since the Consultant recommends that the Gwin site remain in place.

Staff agrees with the Consultant's recommendation that the Station 25 tower be removed based on neighborhood concems and has been exploring options for the Council to consider that are simple, low-cost solutions but to no avail. Further, while staff agrees that the Skyline site may be an altemative site, the design and deployment effort would require additional resources beyond the preliminary construction costs presented by the Consultant that are also unbudgeted.

Staff agrees with the Consultant that an additional emphasis should be placed on promoting the utilization of the City Microwave Network's available capacity to reduce recurring costs for other telecommunications services, as well as provide enhanced reliability for mission critical applications. The City's need to maintain the City Microwave Network is critical due to the many ongoing public safety technology projects including; replacement of the public safety Computer Aided Dispatch (CAD) system, enhancing our 911 infrastructure in preparation for Next-Generation 911 systems, and other high-bandwidth public safety applications that would support City first responders abilities. Future applications include the ability to enhance safety by providing first responders greater situational awareness, deployment of new media rich technologies to enable them to connect with the City's residents. Most importantly, staff is eager to utilize the City Microwave Network to enhance the network availability of already existing mission critical telecommunication services. Leveraging the City Microwave Network is vital to delivering existing and future public safety technology projects.

Staff agrees with the Consultant's recommendation that the infrastructure at the Seneca and Gwin communications facilities are in need of repair and replacement. Further, staff agrees with the Consultant's statement that *"The City of Oakland must plan on continuing to maintain its microwave network, regardless of whether it decides to stay on its own radio system or move to EBRCS"* and that the City should retain frequency protection services to protect its microwave system from other licensees. As previously conveyed to Council, the City Microwave Network, including its frequency licensing is an important asset for the City that should be maintained and protected.

**G. Policy and Governance**

The Consultant's report reiterates the concern that staff has previously expressed related to the governance of the EBRCS JPA. Specifically, the Consultant has called attention to the fact that if Oakland were to join the EBRCS system, it would represent approximately 17% of the total users of the system, and therefore be responsible for 17% of its total annual operational costs including payment of current and future debt obligations. The Consultant points out that based on the current governance model and user counts, a fair and equitable representation for the City on the JPA Board would be equivalent to four standing seats. Staff agrees with the Consultant that the issue is a prime concern related to the EBRCS alternative discussion and, until this is resolved, the City would be at risk that it would have no influence or ability to control its own radio needs or future budgeted costs. Given that the findings of this report show that the City's fiscal investments are significant, it is extremely important the City's investments are fairly represented going forward. EBRCS' suggestion that it can make one seat available is a start, but does not go far enough in the context of the City's share of membership. More importantly, even with four seats, the City's financial interests could easily be overwhelmed by a voting block of other members.

The Consultant also calls attention to the potential impact any transition would have to external users of the Oakland P25 System. Specifically, the Consultant explains that should the City transition to EBRCS, it would involve a significant project to manage and support these external entities during the transition period. Staff agrees with the Consultant concerning this area of concern and believes that in the event the City does transition to EBRCS, such a project would likely be executed over the course of 12 to 18 months, and additional costs related to managing the transition of the external users would be an additional soft cost that would need to be considered. This is of significant concern because history has shown that the City did not plan or resource well the previous radio efforts which resulted in poor change management.

**H. Operational Sustainability**

The Consultant's report calls attention to a number of operational and management concerns related to the sustainability of maintenance improvements that been put into place over the past 16 months. While these recent improvements are largely credited with the recovery, on-going stability, and greatly improved radio performance for users of the Oakland P25 System, the execution of these activities has been done without an on-going and sustainable support model to utilize existing City staff

The Consultant's has expressed considerable concem that the City has not properly invested into training and properly equipping its own staff to maintain the P25 Radio System, and most importantly, its own ability to maintain the radio subscriber fleet used by the City's first responders. The City is now nearing completion of the first annual maintenance program across the entire public safety radio fieet, and effort that has lasted approximately one year. This effort was largely executed by a contingent of extemal technical assistance from Harris and Dailey & Wells due to the City's lack of staff, operational knowledge, and tools to accomplish the job.

As the Consultant's report points out, these entifies have provided these services at no cost to the City and at great financial cost to themselves. Staff thanks both Harris and Dailey & Wells for their performance and concems for the interest of the City's public safety communications and our first responders. Moving forward, a professional maintenance agreement is required to properly compensate Harris and Dailey & Wells for their maintenance of the City's radio system.

This area of concem was summarized by the Consultant as one of the key areas that the City needs to address as part of any decision related to the future of its radio provider. Staff disagrees with the Consultant recommendation, and the City Charter prohibits, that the City should consider contracting out all responsibilities for radio operations and maintenance but rather, recommends that the City considers properly equipping and training this operational group to be an important and vital City resource that provides support to our City's first responders in a variety of conditions, including but not limited to special events and projects, EOC acfivations, and during various disaster response scenarios. Staff agrees with the Consultant that in either scenario, there would be no cost savings to the City, or reduced headcount by redirecting any existing services to extemal entities, including EBRCS. Staff recommends that it retum to Council with a plan to address the funding and sustainability of this operational group as part of its next steps following any action from this report.

## PUBLIC OUTREACH/INTEREST

This item did not require any additional public outreach other than the required posting on the City's website. Stakeholders named in this report have participated in all areas of the Consultant's report and this has been a transparent and collaborative process.

## COORDINATION

This report was developed in consultation with staff in the Budget Office and the City Attorney's Office. Stakeholders have been involved and it has been a transparent and collaborative process.

## COST SUMMARY/IMPLICATIONS

As recommended in this report and discussed in Section E, the cost implications are significant and require both a deeper fiscal analysis and budget and financing plan. For this reason, staff has requested 90-120 days to return to the City Council at a time that coincides with the receipt of the 2nd Quarter Revenue & Expenditure report and the Council's direction to rebalance the

budget to account for other expenditures that resulted in an unbalanced budget. These expenditures will greatly impact the City's two year budget and represent significant investment.

## SUSTAINABLE OPPORTUNITIES

***Economic***: There are no economic opportunities associated with this report.

***Environmental***: There are no environmental opportunities associated with this report.

***Social Equity***: There are no social equity opportunities associated with this report.

For questions regarding this report, please contact David Cruise, IS Supervisor, Wireless Services at dcruise@oaklandnet.com or (510) 238-3917.

Respectfully submitted,

/s/

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David Cruise
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ATTACHMENTS:

(A) RCC Consultant's Supplement 1 P25 In-building coverage analysis
(B) RCC Consultant's Supplement 2 P25 analysis

# City of Oakland, California

## Supplement 1 to the P25 System Evaluation Report Performance Evaluation of the City of Oakland and EBRCS Radio Networks in and In-Building Environment

## June 21, 2013

**Prepared by RCC Consultants, Inc.**

Tom Gray, Executive Sponsor

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Adolfo Bello, Data Analyst

John Chartkoff, Test Designer and Field Tester

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# Executive Summary

This report summarizes the key findings from a series of coverage measurements taken inside Oakland buildings between May 6 and May 21, 2013, as a follow up to a report prepared for the City of Oakland in May 2012, which provided an assessment of the City's P25 system.

Among the various findings in the May 2012 report were two items that led to this report:

1. A statement indicating that the City's current system may not provide sufficient signal strength to provide public safety level coverage inside larger buildings in the Oakland area.

2. A recommendation to investigate the EBRCS regional P25 system as a possible alternative to continuing to invest in the City's P25 system.

Since then the City has followed a number of the technical recommendations to improve the performance of the City's P25 system. In late 2012, the City began discussions with RCC about returning to perform a follow up study that focused on the signal provided by *both* systems inside large buildings. RCC agreed to return and spend a couple of weeks taking signal readings at test points inside a number of buildings selected by the City. The City provided a list of 30 candidate buildings for testing, with the goal of measuring both Received Signal Strength (RSS) and Bit Error Rate (BER) at 5 points inside each building (with additional floors being tested inside taller buildings).

The City and RCC engaged EBRCS in the planning process. When it was determined that the EBRCS transmitter sites could not generate the P25 1011 test pattern needed to perform the BER test, the BER test was dropped from the scope of the study. (EBRCS can generate that pattern from an external radio and relay it through the transmitter site, but it was decided that would not provide an apples-to-apples comparison, as the EBRCS signal would be relayed, while the Oakland signal would only be making a single trip.)

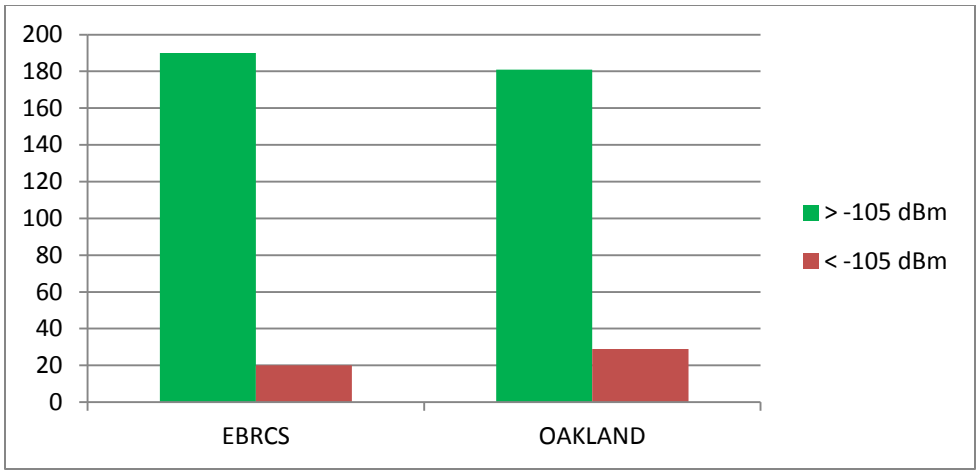
RCC developed custom software to read Harris radios and capture the RSS information in real time. A Harris P7200 portable was used as the primary test radio, assessing performance on both the Oakland Harris P25 and EBRCS Motorola P25 systems. A Harris XG75 portable radio was also used where time and test conditions allowed.

RCC captured RSS readings from the P7200 radio at 210 test points on 42 floors in 24 buildings between May 6 and May 21. Each test point measured readings from both the Oakland and EBRCS systems. RCC captured data from the XG75 radio at another 90 test points on 18 floors in 14 buildings.

The test results indicate that both systems provide adequate signal strength inside the majority of test points in the majority of buildings. 86.2% of the points sampled by the P7200 radio using the Oakland system exceeded the City's target signal strength of -105 dBm. 90.5% of the points tested by the same radio on the EBRCS system exceeded that threshold.

The detailed results for each building, floor, and test point can be found in Appendix 1.

The bar graph below provides a quick visual summary of the test results for the P7200 radio.




**Histogram of Average Signal Levels for P7200 Radio**

The results from these tests should not be extrapolated to make any general assessment of coverage provided inside buildings Citywide, as building construction varies significantly from building to building and signal strength varies significantly from building to building.

The results likewise should not be extrapolated to draw conclusions about any one specific building, as a larger number of sample points spaced closer together is required to make a statistically valid assessment of any one particular building. The objective of this testing and this study was to draw a comparison between the Oakland and EBRCS systems in an in-building environment.

# 1. Introduction

This report summarizes the key findings from a series of signal strength measurements taken inside Oakland buildings between May 6 and May 21, 2013.

Received Signal Strength readings were taken from the two P25 public safety trunked radio systems covering the Oakland area, i.e. City of Oakland Harris P25 and the EBRCS Motorola P25 systems. Readings were taken using the Harris P7200 model radio.

The sections that follow provide some background history regarding the assessment of the City of Oakland P25 system in Section 2, describe the test procedure and setup in Section 3, describe the analysis of the data collected in Section 4, provide a condensed summary of the results in Section 5, and present Conclusions in Section 6. Appendix 1 provides more detailed data regarding the signal strength measured at each test point, and is grouped by floor and building. and indicates which system was stronger at that point and by how much.

# 2. Background

RCC Consultants, Inc. was retained by the City of Oakland in late 2011 to perform an assessment of the City's P25 digital public safety radio system. RCC's assessment of the City's system was delivered in May 2012.

RCC's assessment included measurement of the Received Signal Strength (RSS) and the Bit Error Rate (BER) that the City's 3-site simulcast system provided within the City limits of Oakland, Piedmont, and Alameda. One of the issues noted in the May 2012 report was a concern that the City's three transmitter sites might not provide a strong enough signal to reliably penetrate "large" buildings, such as hospitals, high rise office buildings, shopping malls, etc.

The City of Oakland asked RCC to perform a brief follow up investigation of the in-building coverage issues by taking sample signal strength readings inside a number of larger buildings selected by the City.

RCC developed a custom software program that would allow a laptop computer to communicate with Harris handheld radios to extract RSS and BER readings. This would allow RCC to record what a handheld radio would "see" inside the buildings under test. This test provides a better indication of actual radio performance than using other test measurement devices such as a service monitor.

The City of Oakland also asked RCC to take readings from both the City of Oakland system and the new East Bay Regional Communications System (EBRCS). RCC communicated with both the City of Oakland and the East Bay Regional Communications System Administration (EBRCSA) to develop the protocol for testing.

The City and RCC decided to measure the signal from both systems using the same portable radio in order to eliminate differences in portable radio equipment from the comparison of the two systems. Further, the City has an investment in Harris radios and it was important to see how these radios worked on both systems. Using the same radio for both systems ensured that the received signal level from

each system would be the only difference, and not the sensitivity of the radio equipment or the radio's antenna performance.

The City asked RCC to test both systems using two radio models: the Harris P7200 and the Harris XG75. RCC took measurements with the P7200 at each test point. Where time and conditions allowed, RCC also took informational readings with the XG75.

In the end, the tests performed did NOT include a BER test, as the two systems were not both able to generate and transmit the P25 1011 (TIA 102) test pattern from the transmitter site equipment. The Motorola system could generate a different BER pattern (V.52) from the infrastructure, or could generate the 1011 pattern from a desktop radio and send it over the air to be repeated by the Motorola system infrastructure. As these did not amount to identical tests, the City elected to drop the BER test from the scope of the in-building tests.

The received signal strength measurement is a good indication as to how strong a signal is, but it does not provide a complete picture of the effects of the environment. A signal may appear to be strong in a particular place, but users may find it unusable due to interference from other sources. By incorporating the BER measurement for the two systems, it might have been possible to determine if the received signal strength suffers from any simulcast timing issues or outside interference which would produce a higher Bit Error Rate. As the Bit Error Rate increases, the signal becomes less usable (less intelligible).

The City provided a list of 30 candidate buildings for testing. RCC agreed to provide a test technician to test as many points as possible during a two week period in May, with a goal of sampling at least five points in each building tested. In buildings with multiple floors, every third floor would be tested. In some special cases, such as the Police Admin Building, five samples were taken on each floor.

(RCC practice runs determined that signal measurement would take approximately 12 minutes per test point using two radios for two systems. This equates to roughly an hour per floor for five test points.)

# 3. Procedure and Setup

This testing effort for the City of Oakland involved the measurement of signals inside buildings as delivered by the City's own system (OAK), a Harris P25 system; and by the regional system known as the East Bay Regional Communications System (EBRCS), a Motorola P25 system. The Received Signal Strength (RSS) values were recorded in dBm and were time tagged for both systems.

It was the objective of this test effort to capture signal strength readings inside buildings at a minimum of 150 test points in 20 to 30 buildings. A minimum of five (5) samples were be collected inside each building (or campus) tested.

In multi-story buildings, RCC typically performed tests on the top, middle, and ground floors. In a few buildings such as the Police Administration Building, additional floors or basement levels were also tested.

For the majority of buildings, the ground floor was obvious and unique, however, buildings found on slopes may be considered to have multiple ground levels. To minimize confusion, the ground level was defined as the level where the main entrance is located.

## 3.1 Test Procedure

The general procedure was as follows:

1. Drive to the next building to be tested.

2. Initiate contact with the building escort and explain the test process we will be performing.

3. When arriving at an indoor test location make sure to:

    a. Position the first radio in the middle of the testing surface in a vertical position
    b. Record the location number (i.e. Test Point: 1)
    c. Record the location description (i.e. In Hallway in front of office 100)
    d. Record the time (see clarification for time recordings) (i.e. 15:23 representing 3:23 PM)
    e. Connect P7200 to laptop computer via serial port.
    f. Ensure active control channels are selected in software.
    g. Initialize data collection software
    h. Start data collection for Radio 1
    i. Stop data collection after 3 minutes
    j. Save data file for Radio 1
    k. Swap test radios
    l. Start data collection for Radio 2
    m. Stop data collection after 3 minutes
    n. Save data file for Radio 1
    o. Archive data files

4. Move to the next test location and repeat step 4 as required or until the building is completed.

## 3.2 Equipment Used

The following equipment was during testing:

- Panasonic Toughbook CF-30 and software to Interface to Harris Portable radios.
- Two radio interface cables
- Two Harris portable radios with corresponding accessories.
    - One Harris P7200 portable with 4" antenna
    - One Harris XG75 portable with 4" antenna
    - Lithium Ion batteries on both radios

**Equipment Connection Diagram**


## 3.3 Test Frequencies

The test frequencies used for this process were the active control channels for each system. One belongs to the City of Oakland, and the other belongs to EBRCS. During the test period, the control channel for each system may have rolled from time to time, but was primarily:

| System | Base Transmit Frequency |
|---|---|
| City of Oakland | 853.70000 MHz |
| EBRCS | 773.74375 MHz |

## 3.4 Candidate Building List

The following list of candidate buildings was provided to RCC. 24 of the buildings listed were tested using the P7200 radio before a hard drive crash halted testing on May 22. 18 buildings were also tested informally using the XG75 radio.

1. Police Administration Building
2. Eastmont Police Substation
3. Oakland EOC (Fire Station 1)
4. Oakland Edgewater 911 Center (MSC)
5. 150 Frank Ogawa Plaza
6. 250 Frank Ogawa Plaza
7. Oakland City Hall
8. Oakland Federal Building (not tested)
9. Oakland State Building
10. Oakland Coliseum (During Oakland A's Game)
11. Oracle Arena (During Warriors Game)
12. Oakland Airport Terminal 1
13. Oakland Airport Terminal 2
14. Oakland Airport Hangar 4 (ARGUS OPD Air Hangar – not tested)
15. Highland Hospital
16. Oakland Children's Hospital
17. Alameda County Medical Center (not tested)
18. Alta Bates Hospital
19. Summit - Merritt Pavilion
20. Skyline High School (not tested)
21. Castlemont High School (not tested)
22. Oakland High School (not tested)
23. Barack Obama Academy
24. Bret Harte Middle School
25. West Oakland Middle School
26. Merritt College
27. Mills College
28. Holy Names University
29. Laney College
30. Kaiser Center - 300 Lakeside Drive

# 4. Data Analysis

A total of 210 test points on 42 building floors were sampled using the P7200 radio. Of those test points, 90 test points on 18 building floors were also tested with the XG75. Each test point included approximately 200 data samples for each radio/system combination. (200 data samples for the P7200 radio on the Oakland system, 200 data samples for the P7200 radio on the EBRCS system, 200 samples for the XG75 radio on the Oakland system, and 200 samples for the XG75 radio on the EBRCS system.) In all, approximately 120,000 signal strength readings were captured for data analysis during the in-building tests.

The analysis of the captured data consisted of averaging the measured signals at each test point for each radio and each system. For each radio-system combination, there were approximately 200 measurements taken. For example, on one level, five locations were tested using the P7200 radio switching back and forth between the Oakland and the EBRICS system, yielding a total of approximately 2000 readings for that radio. If the XG75 radio was also used, then an additional 2000 readings were collected on that floor.

At every test point, an average was computed, per radio, for the Oakland readings and for the EBRCS readings, in dBm. All points on a given floor were also averaged to provide the average signal strength value for that floor. (See Appendix 1 for average signal strength readings at each point.)

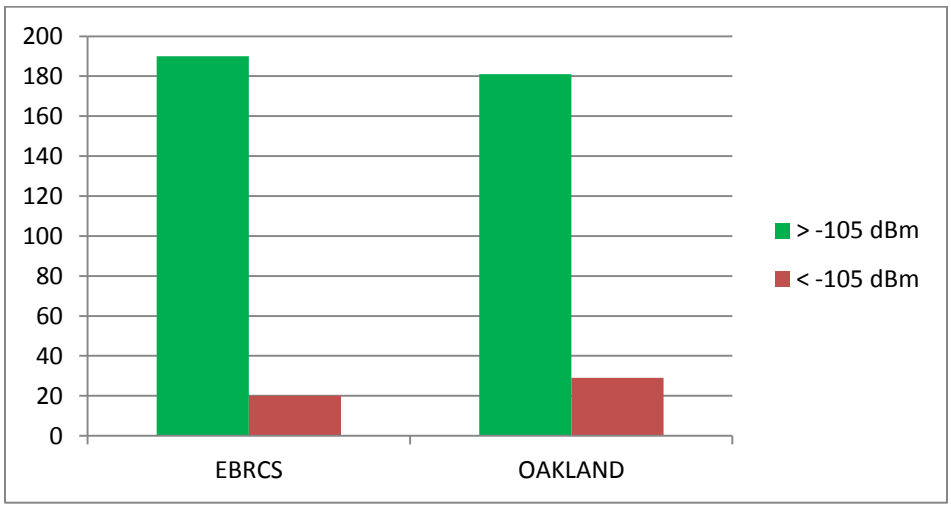
All recorded data points were included in the results calculation.

# 5. Results and Observations

The Tables in Appendix 1 show the average signal strength received by each radio at each test point and the average signal strength for each floor (the average of each of the points on that floor). The cells in those tables are color-coded to show where the average received signal strength was greater than -105 dBm (green) or less than -105 dBm (red).

The overall statistics for each system / radio combination break down as follows for each radio:

| Target Signal Threshold: | EBRCS | Oakland |
|---|---|---|
| Greater than -105 dBm (passing): | 190 test points (90.5%) | 181 test points (86.2%) |
| Below -105 dBm: | 20 test points (9.5%) | 29 test points (13.8%) |




11 buildings met or exceeded the target threshold of -105 dBm at all points using both systems. 4 buildings failed to meet that target at at least one point using the Oakland system, and 1 building failed to meet that target at one test point on the EBRCS system. 9 buildings had at least one failed point on both systems. (Typically at the same point.)

In each of the following 11 buildings, all five test points met or exceeded the -105 dBm threshold when testing both systems:

2. Eastmont Police Substation
3. Oakland EOC (Fire Station 1)
4. Oakland Edgewater 911 Center (MSC)
7. Oakland City Hall
9. Oakland State Building
10. Oakland Coliseum (During Oakland A's Game)
15. Highland Hospital
16. Oakland Children's Hospital
23. Barack Obama Academy
25. West Oakland Middle School

29. Laney College

In each of the following 4 buildings, at least one point failed to meet the -105 dBm threshold for the Oakland system only:

5. 150 Frank Ogawa Plaza
6. 250 Frank Ogawa Plaza
24. Bret Harte Middle School
28. Holy Names University

In the following building, at least one point failed to meet the -105 dBm threshold for the EBRCS system only:

30. Kaiser Center - 300 Lakeside Drive

In each of the following 9 buildings, one or more points failed to meet the -105 dBm threshold on both systems:

1. Police Administration Building
11. Oracle Arena (During Warriors Game)
12. Oakland Airport Terminal 1
13. Oakland Airport Terminal 2
18. Alta Bates Hospital
19. Summit - Merritt Pavilion
26. Merritt College
27. Mills College

In the Police Admin Building, a total of 50 points were tested on 10 floors. Only 1 point failed on the Oakland system (98% passed), and only 2 points failed (96% passed) on the EBRCS system. (Respectively, 98% and 96% of the points tested passed on each system.)

Alta Bates Hospital and Merritt College were the facilities with the poorest test results. In each of those buildings, 4 of the 5 test points failed to meet the -105 dBm target threshold.

# 6. Conclusion

Both systems provided adequate radio signal for handheld radios inside buildings at the majority of the points tested. **The Oakland system provided at least a -105 dBm signal at 86.2% of the points tested**, while **the EBRCS system provided at least a -105 dBm signal at 90.5% of the points tested**.

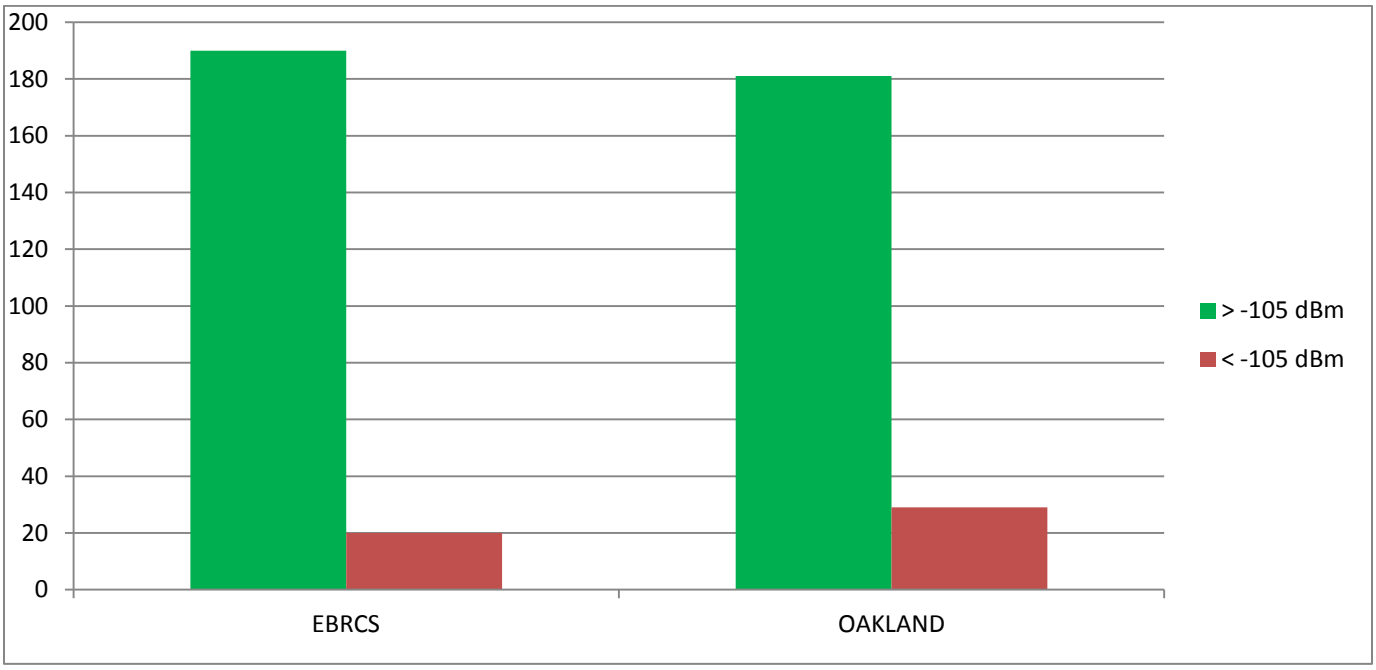
The tests performed measured signal strength only. No BER tests were performed for either system, since the EBRCS system was unable to generate the 1011 test pattern from its transmitter site equipment.

The results should not be extrapolated to make any general assessment of coverage provided inside buildings Citywide, as building construction varies significantly from building to building and signal strength varies significantly from building to building.

The results likewise should not be extrapolated to draw conclusions about any one specific building, as a larger number of sample points spaced closer together is required to make a statistically valid assessment of any one particular building.

## Appendix 1 – Average Measured Signal Strength Data

The following bar graph illustrates the relative number of points that passed or failed the -105 dBm threshold for each system using the P7200 radio.




**Histogram of Average Signal Levels for P7200 Radio**

| Target Signal Threshold: | EBRCS | Oakland |
|---|---|---|
| Greater than -105 dBm (passing): | 190 test points (90.5%) | 181 test points (86.2%) |
| Below -105 dBm: | 20 test points (9.5%) | 29 test points (13.8%) |

## P7200 – Average Received Signal Strength Readings by Test Point

The following tables display average Received Signal Strengths recorded from the P7200 radio for the Oakland system (AVG_OAK) and the EBRCS System (AVG_EBRCS), along the with the Standard Deviation of the individual readings and the total number of data samples collected at that point.

**Data Key:**

| |
|---|
| Received Signal Strength greater than -105 dBm |
| Received Signal Strength less than -105 dBm |

## 1. Police Administration Building

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -102.6486486 | 5.743615221 | 222 | -104.5315315 | 6.309254597 | 222 | 6028 | 22 |
| -88.98648649 | 1.576064546 | 222 | -89.66203704 | 5.641345998 | 216 | 6028 | 159 |
| -107.6454545 | 3.011655785 | 220 | -91.02242152 | 7.184470205 | 223 | 6135 | 98 |
| -103.361991 | 5.033993862 | 221 | -73.22522523 | 5.17247271 | 222 | 6227 | 22 |
| -94.86818182 | 4.886463117 | 220 | -63.28251121 | 3.642344677 | 223 | 6227 | 159 |

BASEMENT

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -102.8144796 | 5.270584608 | 221 | -111.7013575 | 4.688617548 | 221 | 6028 | 22 |
| -93.18888889 | 2.770129757 | 180 | -65.47159091 | 5.184514279 | 176 | 6028 | 159 |
| -104.9955157 | 2.542428714 | 223 | -76.39366516 | 5.326072718 | 221 | 6135 | 98 |
| -78.34684685 | 2.730995868 | 222 | -69.46606335 | 1.955174341 | 221 | 6227 | 22 |
| -88.73755656 | 3.899171404 | 221 | -62.80630631 | 3.091859968 | 222 | 6227 | 159 |

FLOOR 1

## 1. Police Administration Building (cont'd)

**01A CH1 P7200** — FLOOR 2

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -85.74660633 | 3.904432187 | 221 | -94.93721973 | 4.912349338 | 223 | 6028 | 22 |
| -105.7702703 | 4.090206703 | 222 | -94.33333333 | 4.267780862 | 216 | 6028 | 159 |
| -76.28699552 | 2.845600593 | 223 | -87.14027149 | 5.144569769 | 221 | 6135 | 98 |
| -68.85067873 | 4.2287288 | 221 | -79.44394619 | 3.955295986 | 223 | 6227 | 22 |
| -87.78828829 | 2.762916642 | 222 | -87.43243243 | 4.163234084 | 222 | 6227 | 159 |

**01A CH1 P7200** — FLOOR 3

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -100.8288288 | 6.102998112 | 222 | -104.9054054 | 5.685184968 | 222 | 6028 | 22 |
| -75.39366516 | 5.075230013 | 221 | -73.41013825 | 2.139247116 | 217 | 6028 | 159 |
| -76.24324324 | 1.607202208 | 222 | -80.54298643 | 1.891177638 | 221 | 6135 | 98 |
| -90.96396396 | 3.682975209 | 222 | -102.5113122 | 4.585164674 | 221 | 6227 | 22 |
| -63.99099099 | 1.513113092 | 222 | -87.36036036 | 5.019045704 | 222 | 6227 | 159 |

**01A CH1 P7200** — FLOOR 4

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -59.22072072 | 1.797666517 | 222 | -60.83710407 | 0.953786108 | 221 | 6028 | 22 |
| -70.70319635 | 4.224061571 | 219 | -82.09049774 | 4.302319694 | 221 | 6028 | 159 |
| -74.18918919 | 3.380844398 | 222 | -86.57207207 | 4.181594473 | 222 | 6135 | 98 |
| -64.41891892 | 3.984154441 | 222 | -64.24886878 | 1.396932056 | 221 | 6227 | 22 |
| -66.46153846 | 5.809444926 | 221 | -69.4529148 | 2.155294764 | 223 | 6227 | 159 |

## 1. Police Administration Building (cont'd)

**01A CH1 P7200** — FLOOR 5

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -60.15765766 | 2.794210224 | 222 | -61.81900452 | 1.165332924 | 221 | 6028 | 22 |
| -62.67619048 | 1.884183669 | 210 | -82.41428571 | 3.960907744 | 210 | 6028 | 159 |
| -68.67873303 | 3.22503703 | 221 | -82.0045045 | 3.568968503 | 222 | 6135 | 98 |
| -71.46606335 | 4.578107725 | 221 | -78.47297297 | 4.258256732 | 222 | 6227 | 22 |
| -61.57466063 | 1.232178595 | 221 | -66.3632287 | 0.971620907 | 223 | 6227 | 159 |

**01A CH1 P7200** — FLOOR 6

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -61.37387387 | 1.804930989 | 222 | -71.03603604 | 2.086057694 | 222 | 6028 | 22 |
| -63.85388128 | 3.559020199 | 219 | -89.35294118 | 5.489854522 | 221 | 6028 | 159 |
| -66.15765766 | 3.746178736 | 222 | -84.55855856 | 6.109387013 | 222 | 6135 | 98 |
| -67.68918919 | 1.737989235 | 222 | -81.49773756 | 3.220141773 | 221 | 6227 | 22 |
| -69.85650224 | 2.243517259 | 223 | -79.4841629 | 5.189672686 | 221 | 6227 | 159 |

**01A CH1 P7200** — FLOOR 7

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -63.40723982 | 3.312063636 | 221 | -65.28971963 | 2.107484297 | 214 | 6028 | 22 |
| -60.60287081 | 1.906514991 | 209 | -67.3364486 | 2.517334924 | 214 | 6028 | 159 |
| -71.32579186 | 5.271942451 | 221 | -78.41891892 | 3.147965328 | 222 | 6135 | 98 |
| -64.09954751 | 2.533242581 | 221 | -81.6981982 | 4.823950091 | 222 | 6227 | 22 |
| -62.1719457 | 2.165290305 | 221 | -70.3963964 | 1.838646361 | 222 | 6227 | 159 |

## 1. Police Administration Building (cont'd)

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -70.54298643 | 4.968464931 | 221 | -79.64864865 | 5.48572586 | 222 | 6028 | 22 |
| -67.13181818 | 5.442592584 | 220 | -75.07943925 | 4.803974065 | 214 | 6028 | 159 |
| -67.63348416 | 4.461610093 | 221 | -77.43497758 | 4.565246298 | 223 | 6135 | 98 |
| -71.54298643 | 5.224436302 | 221 | -75.16143498 | 2.147896877 | 223 | 6227 | 22 |
| -59.84162896 | 2.165280806 | 221 | -61.51801802 | 1.148337236 | 222 | 6227 | 159 |

FLOOR 8

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -72.52941176 | 5.315098059 | 221 | -79.01351351 | 3.886954315 | 222 | 6028 | 22 |
| -72.78703704 | 3.718091348 | 216 | -84.53153153 | 5.939087213 | 222 | 6028 | 159 |
| -65.12217195 | 2.635165475 | 221 | -72.48430493 | 2.324657359 | 223 | 6135 | 98 |
| -70.40271493 | 2.122561029 | 221 | -79.38288288 | 3.369046588 | 222 | 6227 | 22 |
| -60.03167421 | 1.07191053 | 221 | -81.8018018 | 5.081810024 | 222 | 6227 | 159 |

FLOOR 9

## 2. Eastmont Police Substation

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -74.12206573 | 1.455027542 | 213 | -62.38738739 | 1.353200805 | 222 | 6028 | 159 |
| -62 | 1.354289992 | 218 | -68.37387387 | 1.199487953 | 222 | 6120 | 159 |
| -82.65 | 4.475223522 | 220 | -75.79262673 | 2.405306828 | 217 | 6227 | 22 |
| -66.04524887 | 1.778083124 | 221 | -77.01843318 | 4.034530508 | 217 | 6227 | 159 |

## 3. Oakland EOC

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -62.13063063 | 2.360316444 | 222 | -70.24186047 | 1.853795369 | 215 | 5000 | 100 |
| -73.40552995 | 4.378140864 | 217 | -77.97309417 | 2.881940166 | 223 | 6120 | 83 |
| -70.12442396 | 3.377239006 | 217 | -69.76388889 | 3.291255739 | 216 | 6120 | 98 |
| -69.05092593 | 1.948690455 | 216 | -73.54504505 | 1.115602123 | 222 | 6135 | 83 |
| -66.76470588 | 1.808772444 | 221 | -82.20547945 | 3.882301304 | 219 | 6135 | 98 |

## 4. Police Dispatch

**01A CH1 P7200**

| **AVG_EBRCS** | **STDEV_EBRCS** | **CNT_EBRCS** | **AVG_OAK** | **STDEV_OAK** | **CNT_OAK** | **GRIDX** | **GRIDY** |
|---|---|---|---|---|---|---|---|
| -100.7799043 | 5.115904498 | 209 | -97.16203704 | 4.432086339 | 216 | 6028 | 83 |
| -94.42790698 | 4.093893651 | 215 | -100.4279279 | 4.476356614 | 222 | 6135 | 22 |
| -99.07207207 | 4.908597521 | 222 | -95.0372093 | 5.498386478 | 215 | 6135 | 83 |
| -98.93243243 | 5.055343701 | 222 | -101.1574074 | 4.49011739 | 216 | 6135 | 159 |
| -86.71100917 | 2.360185865 | 218 | -101.0046948 | 3.412653553 | 213 | 6227 | 98 |

## 5. 150 Frank Ogawa Plaza

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY | **FLOOR 1** |
|---|---|---|---|---|---|---|---|---|
| -91.56164384 | 5.08095825 | 219 | -98.07009346 | 4.865297543 | 214 | 6028 | 98 | |
| -95.47465438 | 6.828626631 | 217 | -106.7647059 | 5.941290304 | 221 | 6120 | 159 | |
| -89.52941176 | 5.610484837 | 221 | -85.07373272 | 5.206308618 | 217 | 6135 | 83 | |
| -94.40865385 | 6.219132247 | 208 | -95.69683258 | 3.766290545 | 221 | 6135 | 1000 | |
| -84.38862559 | 4.391622274 | 211 | -91.77419355 | 5.371364181 | 217 | 6227 | 159 | |

## 5. 150 Frank Ogawa Plaza (cont'd)

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY | |
|---|---|---|---|---|---|---|---|---|
| -110.4383562 | 2.794094204 | 219 | -115.4298643 | 2.635563504 | 221 | 6028 | 22 | FLOOR 4 |
| -104.1291866 | 2.1320719 | 209 | -114.8732394 | 1.46914406 | 213 | 6028 | 128 | |
| -101.0607477 | 3.212512421 | 214 | -114.2081448 | 2.495837753 | 221 | 6028 | 159 | |
| -96.61860465 | 1.733029304 | 215 | -104.9727273 | 1.216020089 | 220 | 6028 | 222 | |
| -87.1040724 | 2.523171106 | 221 | -102.1146789 | 2.545559998 | 218 | 6227 | 22 | |

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY | |
|---|---|---|---|---|---|---|---|---|
| -89.72093023 | 3.485119109 | 215 | -100.8378378 | 2.844509009 | 222 | 6028 | 22 | FLOOR 7 |
| -86.3963964 | 2.889454314 | 222 | -98.8156682 | 2.66373687 | 217 | 6028 | 159 | |
| -88.01843318 | 5.171112007 | 217 | -88.61792453 | 3.829328011 | 212 | 6135 | 98 | |
| -90.01395349 | 4.395706348 | 215 | -105.1628959 | 4.021609666 | 221 | 6227 | 22 | |
| -77.96261682 | 3.064027953 | 214 | -82.59641256 | 1.593451026 | 223 | 6227 | 159 | |

## 6. 250 Frank Ogawa Plaza

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY | |
|---|---|---|---|---|---|---|---|---|
| -89.43255814 | 3.92855119 | 215 | -109.5399061 | 4.286282859 | 213 | 6028 | 22 | FLOOR 1 |
| -64.33027523 | 1.082368506 | 218 | -84.29090909 | 2.443313322 | 220 | 6028 | 159 | |
| -89.01363636 | 3.34947627 | 220 | -101.8714286 | 4.066156604 | 210 | 6135 | 98 | |
| -88.28440367 | 3.892783689 | 218 | -97.43438914 | 3.664509543 | 221 | 6135 | 159 | |
| -79.05607477 | 4.90153138 | 214 | -84.43243243 | 1.903184384 | 222 | 6227 | 159 | |

## 6. 250 Frank Ogawa Plaza (cont'd)

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY | |
|---|---|---|---|---|---|---|---|---|
| -89.43255814 | 3.92855119 | 215 | -109.5399061 | 4.286282859 | 213 | 6028 | 22 | FLOOR 3 |
| -64.33027523 | 1.082368506 | 218 | -84.29090909 | 2.443313322 | 220 | 6028 | 159 | |
| -89.01363636 | 3.34947627 | 220 | -101.8714286 | 4.066156604 | 210 | 6135 | 98 | |
| -88.28440367 | 3.892783689 | 218 | -97.43438914 | 3.664509543 | 221 | 6135 | 159 | |
| -79.05607477 | 4.90153138 | 214 | -84.43243243 | 1.903184384 | 222 | 6227 | 159 | |

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY | |
|---|---|---|---|---|---|---|---|---|
| -89.43255814 | 3.92855119 | 215 | -109.5399061 | 4.286282859 | 213 | 6028 | 22 | FLOOR 6 |
| -64.33027523 | 1.082368506 | 218 | -84.29090909 | 2.443313322 | 220 | 6028 | 159 | |
| -89.01363636 | 3.34947627 | 220 | -101.8714286 | 4.066156604 | 210 | 6135 | 98 | |
| -88.28440367 | 3.892783689 | 218 | -97.43438914 | 3.664509543 | 221 | 6135 | 159 | |
| -79.05607477 | 4.90153138 | 214 | -84.43243243 | 1.903184384 | 222 | 6227 | 159 | |

## 7. Oakland City Hall

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY | |
|---|---|---|---|---|---|---|---|---|
| -78.53153153 | 2.823046138 | 222 | -87.4954955 | 1.641508377 | 222 | 6028 | 22 | FLOOR 1 |
| -62.10810811 | 1.50625454 | 222 | -77.45412844 | 3.002334947 | 218 | 6028 | 159 | |
| -86.86098655 | 5.92014829 | 223 | -90.9638009 | 3.288900346 | 221 | 6135 | 98 | |
| -78.95945946 | 2.348230426 | 222 | -96.14932127 | 4.264052915 | 221 | 6227 | 22 | |
| -71.00900901 | 4.682683022 | 222 | -84.61085973 | 3.745624075 | 221 | 6227 | 159 | |

## 7. Oakland City Hall (cont'd)

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY | |
|---|---|---|---|---|---|---|---|---|
| -78.53153153 | 2.823046138 | 222 | -87.34051724 | 1.785098416 | 232 | 6028 | 22 | FLOOR 3 |
| -61.738041 | 1.753583881 | 439 | -78.05251142 | 2.88204107 | 438 | 6028 | 159 | |
| -60.27927928 | 0.94816967 | 222 | -78.53301887 | 2.357572118 | 212 | 6044 | 22 | |
| -76.27625571 | 11.65597372 | 438 | -83.4361949 | 8.213997605 | 431 | 6135 | 98 | |
| -70.96396396 | 3.311649335 | 222 | -77.20720721 | 2.131925466 | 222 | 6212 | 159 | |
| -70.86682809 | 8.975651468 | 413 | -88.25490196 | 9.412142583 | 408 | 6227 | 22 | |
| -69.79545455 | 5.399955832 | 264 | -83.8358209 | 3.974062026 | 268 | 6227 | 159 | |

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY | |
|---|---|---|---|---|---|---|---|---|
| -71.67567568 | 2.301532687 | 222 | -72.49773756 | 1.539257301 | 221 | 6028 | 22 | FLOOR 11 |
| -78.31981982 | 3.368937688 | 222 | -76.06976744 | 2.984346614 | 215 | 6028 | 159 | |
| -71.93693694 | 4.752287907 | 222 | -78.42986425 | 3.4759975 | 221 | 6135 | 98 | |
| -82.52017937 | 5.525395584 | 223 | -79.23076923 | 3.158848157 | 221 | 6227 | 22 | |
| -71.74324324 | 2.658857701 | 222 | -85.55656109 | 4.777096392 | 221 | 6227 | 159 | |

## 9. Oakland State Building

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -71.1719457 | 2.641853743 | 221 | -73.12162162 | 2.028882197 | 222 | 6028 | 22 |
| -80.09090909 | 2.575066447 | 220 | -76.87037037 | 3.476412459 | 216 | 6028 | 159 |
| -77.1719457 | 4.109559843 | 221 | -68.57657658 | 2.397395078 | 222 | 6135 | 98 |
| -74.09954751 | 5.322255996 | 221 | -74.59009009 | 5.809065391 | 222 | 6227 | 22 |
| -76.29864253 | 3.632110326 | 221 | -77.51351351 | 4.483988336 | 222 | 6227 | 159 |

## 10. Oakland Coliseum

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY | |
|---|---|---|---|---|---|---|---|---|
| -90.98190045 | 4.823205084 | 221 | -89.73873874 | 4.059983977 | 222 | 6028 | 22 | MAIN |
| -96.25225225 | 5.434684014 | 111 | -96.36697248 | 5.854185825 | 109 | 6028 | 159 | |
| -87.39366516 | 4.621467266 | 221 | -88.93721973 | 5.071169649 | 223 | 6135 | 98 | |
| -84.90909091 | 4.050019346 | 220 | -86.26457399 | 4.566520416 | 223 | 6227 | 22 | |
| -97.239819 | 6.023548332 | 221 | -94.04954955 | 4.968887343 | 222 | 6227 | 159 | |

| 01A CH1 P7200 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY | UPPER |
| -79.85201794 | 5.000953329 | 223 | -84.05429864 | 4.086200956 | 221 | 6028 | 22 | |
| -94.07058824 | 6.634664084 | 85 | -93.85882353 | 5.057180047 | 85 | 6028 | 159 | |
| -83.99095023 | 4.302209739 | 221 | -85.42600897 | 5.446103305 | 223 | 6135 | 98 | |
| -80.86818182 | 4.442004398 | 220 | -81.10762332 | 3.814042947 | 223 | 6227 | 22 | |
| -98.35135135 | 5.398422174 | 222 | -100.9234234 | 4.846838872 | 222 | 6227 | 159 | |

## 11. Oracle Arena

| 01A CH1 P7200 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY | FLOOR 1 |
| -102.0585586 | 4.827447326 | 222 | -102.7963801 | 5.158328263 | 221 | 6028 | 22 | |
| -102.5299539 | 6.06983102 | 217 | -100.1447964 | 4.801215053 | 221 | 6028 | 159 | |
| -106.7972973 | 4.730701869 | 222 | -106.0945946 | 3.999441994 | 222 | 6135 | 98 | |
| -100.1576577 | 5.561455091 | 222 | -102.0633484 | 4.585110845 | 221 | 6227 | 22 | |
| -112.3963964 | 4.587567854 | 222 | -112.1711712 | 4.289045024 | 222 | 6227 | 159 | |

## 11. Oracle Arena (cont'd)

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -76.1981982 | 4.28893097 | 222 | -75.79279279 | 3.088783143 | 222 | 6028 | 22 |
| -82.47706422 | 4.970134455 | 218 | -80.97706422 | 4.105119497 | 218 | 6028 | 159 |
| -90.53811659 | 5.046373245 | 223 | -96.35454545 | 4.82589356 | 220 | 6135 | 98 |
| -81.32286996 | 5.015630238 | 223 | -77.87330317 | 5.464951338 | 221 | 6227 | 22 |
| -93.86936937 | 4.876396058 | 222 | -93 | 5.237352791 | 222 | 6227 | 159 |

FLOOR 3

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -82.21395349 | 4.967256402 | 215 | -85.13963964 | 5.026928018 | 222 | 6028 | 22 |
| -66.02752294 | 5.017864336 | 218 | -68.43577982 | 5.266886784 | 218 | 6028 | 159 |
| -74.04072398 | 5.152507547 | 221 | -75.44144144 | 5.092243564 | 222 | 6135 | 98 |
| -77.71945701 | 5.121526022 | 221 | -80.8963964 | 5.990421131 | 222 | 6227 | 22 |
| -75.6367713 | 5.085564482 | 223 | -77.68778281 | 5.048607825 | 221 | 6227 | 159 |

FLOOR 4

## 12. Oakland Airport Terminal 1

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -90.63679245 | 5.348974752 | 212 | -89.12796209 | 4.450545726 | 211 | 6028 | 37 |
| -93.18552036 | 4.698836251 | 221 | -91.54587156 | 4.075350927 | 218 | 6089 | 22 |
| -99.46363636 | 4.344055452 | 220 | -104.0093897 | 3.842403201 | 213 | 6120 | 83 |
| -109.6588785 | 3.59975099 | 214 | -114.0720721 | 2.843462651 | 222 | 6135 | 53 |
| -91.06306306 | 4.983736953 | 222 | -93.46788991 | 4.580199435 | 218 | 6227 | 159 |

## 13. Oakland Airport Terminal 2

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -95.96261682 | 4.874818371 | 214 | -93.27927928 | 4.46944614 | 222 | 5000 | 100 |
| -119.4298643 | 1.00490365 | 221 | -117.4018692 | 1.576588181 | 214 | 6120 | 22 |
| -97.53846154 | 4.437916729 | 221 | -97.34579439 | 2.884645457 | 214 | 6181 | 143 |
| -90.2972973 | 3.302527743 | 222 | -96.67298578 | 4.328441938 | 211 | 6196 | 37 |
| -110.2242991 | 2.640630211 | 214 | -112.0186916 | 3.191777312 | 214 | 6212 | 53 |

## 15. Highland Hospital

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -87.3317757 | 2.705796183 | 214 | -89.22072072 | 6.687661593 | 222 | 6028 | 22 |
| -76.62844037 | 2.506124912 | 218 | -94.82648402 | 6.614345819 | 219 | 6028 | 159 |
| -74.86976744 | 1.921780581 | 215 | -84.53703704 | 4.684315097 | 216 | 6135 | 98 |
| -84.53393665 | 2.859589509 | 221 | -99.79812207 | 4.243929765 | 213 | 6227 | 22 |
| -77.3800905 | 3.260000278 | 221 | -89.8202765 | 5.649479976 | 217 | 6227 | 159 |

## 16. Oakland Children's Hospital

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -82.46606335 | 6.573706397 | 221 | -83.83408072 | 3.04978288 | 223 | 6028 | 22 |
| -96.63181818 | 4.952365457 | 220 | -101.6221198 | 4.869126958 | 217 | 6028 | 159 |
| -80.28699552 | 5.040213194 | 223 | -83.3800905 | 3.996630625 | 221 | 6135 | 98 |
| -81.1036036 | 2.311311078 | 222 | -93.76923077 | 4.312366345 | 221 | 6227 | 22 |
| -90.74324324 | 5.038478576 | 222 | -94.33484163 | 4.222893084 | 221 | 6227 | 159 |

## 18. Alta Bates Hospital

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -117.8963964 | 2.486722313 | 222 | -116.5700935 | 2.858517129 | 214 | 6028 | 22 |
| -119.7612613 | 0.744046801 | 222 | -119.9908257 | 0.095561676 | 218 | 6028 | 159 |
| -119.3284314 | 1.217675849 | 204 | -119.9234694 | 0.349740129 | 196 | 6135 | 98 |
| -97.84684685 | 6.391026229 | 222 | -99.37674419 | 4.957050921 | 215 | 6227 | 22 |
| -120 | 0 | 222 | -119.9907407 | 0.096001005 | 216 | 6227 | 159 |

## 19. Summitt-Merritt Pavilion

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -109.0439024 | 4.593582948 | 205 | -113.7368421 | 3.827108717 | 209 | 6028 | 22 |
| -106.2895928 | 4.963258673 | 221 | -104.40553 | 4.163506226 | 217 | 6028 | 159 |
| -99.13207547 | 4.945341954 | 212 | -102.9954751 | 4.097113993 | 221 | 6135 | 98 |
| -101.6384977 | 5.421465164 | 213 | -100.9633028 | 7.066408634 | 218 | 6227 | 22 |
| -105.7981221 | 3.734287364 | 213 | -115.2432432 | 2.960421323 | 222 | 6227 | 159 |

## 23. Barack Obama Academy

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -88.93981481 | 4.513657617 | 216 | -103.6412556 | 3.01296033 | 223 | 6028 | 22 |
| -73.83796296 | 2.398961698 | 216 | -90.61085973 | 3.907180998 | 221 | 6028 | 159 |
| -84.12921348 | 5.685757849 | 178 | -95.56216216 | 5.425150336 | 185 | 6135 | 98 |
| -65.29906542 | 1.584638424 | 214 | -81.32432432 | 3.136883666 | 222 | 6227 | 22 |
| -65.08219178 | 1.68441391 | 219 | -82.84545455 | 4.827028854 | 220 | 6227 | 159 |

## 24. Bret Harte Middle School

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -89.57534247 | 3.172058957 | 219 | -107.1926606 | 4.032076604 | 218 | 6028 | 22 |
| -90.89351852 | 4.082037183 | 216 | -103.3513514 | 4.792808807 | 222 | 6028 | 159 |
| -92.37674419 | 5.633048228 | 215 | -99.91928251 | 4.58382737 | 223 | 6135 | 98 |
| -81.48401826 | 1.379226721 | 219 | -104.109589 | 4.467707714 | 219 | 6227 | 22 |
| -88.05529954 | 1.264428588 | 217 | -106.4054054 | 4.339398333 | 222 | 6227 | 159 |

## 25. West Oakland Middle School

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -58.86877828 | 1.177814946 | 221 | -77.50900901 | 3.958770538 | 222 | 6028 | 22 |
| -75.14155251 | 6.62030927 | 219 | -68.84615385 | 1.144355868 | 208 | 6028 | 159 |
| -67.29411765 | 2.347031348 | 221 | -80.51569507 | 2.525273214 | 223 | 6135 | 98 |
| -68.77375566 | 2.523244469 | 221 | -67.0045045 | 3.001504521 | 222 | 6227 | 22 |
| -61.54504505 | 3.688706961 | 222 | -74.29411765 | 2.520716306 | 221 | 6227 | 159 |

## 26. Merritt College

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -106.8190045 | 4.413182824 | 221 | -108.5345622 | 3.156409399 | 217 | 6028 | 22 |
| -105.4587156 | 4.641094957 | 218 | -114.479638 | 2.737914245 | 221 | 6028 | 159 |
| -110.7004608 | 4.210618166 | 217 | -110.1278539 | 2.954098452 | 219 | 6135 | 98 |
| -90.71559633 | 3.917564707 | 218 | -100.6227273 | 3.881631232 | 220 | 6227 | 22 |
| -105.9041096 | 3.646656318 | 219 | -112.1203704 | 3.833069309 | 216 | 6227 | 159 |

## 27. Mills College

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -103.638009 | 2.014764507 | 221 | -104.3194444 | 2.031105019 | 216 | 6028 | 22 |
| -97.17050691 | 2.600472931 | 217 | -107.4727273 | 3.712767287 | 220 | 6028 | 159 |
| -113.0593607 | 4.150952312 | 219 | -115.3484163 | 4.132010267 | 221 | 6135 | 98 |
| -97.47663551 | 2.660247418 | 214 | -91.67420814 | 3.120710137 | 221 | 6227 | 22 |
| -97.90950226 | 4.421121847 | 221 | -99.2 | 2.700583397 | 220 | 6227 | 159 |

## 28. Holy Names University

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -87.52336449 | 2.542948621 | 214 | -97.07207207 | 3.985747712 | 222 | 6028 | 22 |
| -101.4074074 | 3.612734678 | 216 | -107.3732719 | 3.11564524 | 217 | 6028 | 159 |
| -96.95945946 | 5.436858928 | 222 | -92.60185185 | 2.898082172 | 216 | 6135 | 98 |
| -89.51141553 | 4.314856701 | 219 | -90.11818182 | 1.816875828 | 220 | 6227 | 22 |
| -88.36818182 | 5.331553901 | 220 | -95.95890411 | 2.342889043 | 219 | 6227 | 159 |

## 29. Laney College

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -87.99530516 | 2.643071492 | 213 | -74.42792793 | 4.373070019 | 222 | 6028 | 22 |
| -84.60730594 | 4.586692113 | 219 | -83.88479263 | 4.565429585 | 217 | 6135 | 98 |
| -96.05990783 | 4.124352473 | 217 | -93.10859729 | 3.358431496 | 221 | 6227 | 22 |
| -97.23423423 | 5.521582426 | 222 | -95.55813953 | 3.466140125 | 215 | 6227 | 159 |

## 30. Kaiser Center

**01A CH1 P7200**

| AVG_EBRCS | STDEV_EBRCS | CNT_EBRCS | AVG_OAK | STDEV_OAK | CNT_OAK | GRIDX | GRIDY |
|---|---|---|---|---|---|---|---|
| -87.04504505 | 2.76659906 | 222 | -83.67117117 | 1.30608651 | 222 | 6028 | 22 |
| -94.83257919 | 5.27119334 | 221 | -86.58525346 | 1.861740538 | 217 | 6028 | 159 |
| -103.7342342 | 5.422143229 | 222 | -98.55855856 | 3.107965783 | 222 | 6135 | 98 |
| -105.841629 | 13.30984888 | 221 | -104.3183857 | 11.73705816 | 223 | 6227 | 22 |
| -104.5520362 | 5.011192738 | 221 | -100.9369369 | 5.781510988 | 222 | 6227 | 159 |