HUGH WILLIAMSON ASSOCIATES INC.
Ottawa Ontario Canada

ADDENDUM 1 ADDRESSING ADDITIONAL OPERATING SCENARIOS AT SITE 5C FOR THE NOISE CONTROL PLAN FOR THE COMBINED SEWAGE STORAGE TUNNEL SITE 5 STANLEY PARK & VICINITY

CITY OF OTTAWA

Prepared for

Explotech Engineering Ltd.

Prepared by

Hugh Williamson Associates Inc.

14th August 2017

Postal Address: PO Box 74056, RPO Beechwood, Ottawa, Ontario, K1M 2H9, Canada
Phone/Fax: 613 747 0983, Email: info@hwacoustics.ca, Web: http://www.hwacoustics.ca

ADDENDUM 1
ADDRESSING ADDITIONAL OPERATING SCENARIOS AT SITE 5C FOR THE NOISE CONTROL PLAN FOR THE COMBINED SEWAGE STORAGE TUNNEL SITE 5 STANLEY PARK & VICINITY CITY OF OTTAWA

Table of Contents

Tables: 7

Figures: 11

Resumes: Hugh Williamson, Michael Wells

ADDENDUM 1
ADDRESSING ADDITIONAL EQUIPMENT OPERATIONS AND CONDITIONS AT SITE 5C FOR THE NOISE CONTROL PLAN FOR THE COMBINED SEWAGE STORAGE TUNNEL SITE 5 STANLEY PARK & VICINITY CITY OF OTTAWA

1.0 Introduction

This addendum provides supplementary information to the "*Noise Control Plan for the Combined Sewage Storage Tunnel Site 5 Stanley Park and Vicinity, City of Ottawa"* prepared by Hugh Williamson Associates, Issued 8th March, 2017 (NCP).

The purpose of the Noise Control Plan is to provide noise control and noise monitoring recommendations to meet the requirements of the City of Ottawa specification Section 02482, for the Combined Sewage Storage Tunnel (CSST), Contract No. ISD14-2036, being constructed by Dragados-Tomlinson Joint Venture in the City of Ottawa.

The NCP was based on a study of noise from equipment operations and conditions anticipated at the Site 5, Staging Areas 5A, 5B and 5C. City of Ottawa Specification 02482 sets sound level thresholds for noise impacts due to site operations at nearby noise sensitive land uses.

At the request of the City of Ottawa, Hugh Williamson Associates Inc. has undertaken the following acoustic analysis which considers the impacts on nearby noise sensitive land uses of noise generated by additional equipment operations and additional conditions at Site 5C.

The equipment operations and conditions included in this addendum are as follows:

Scenario 1: *Hoe Ram operations occurring on the surface during site preparation at Site 5C – Un-shielded (Monday to Friday, 7 am to 7 pm only)*

Scenario 2: *Rock Drill operations occurring on the surface during the construction of the noise barrier at Site 5C – Un-shielded (Monday to Friday, 7 am to 7 pm only).*

Additional points of reception have been included at Site 5C to represent sound levels at a number of nearby residences for each scenario analyzed. A receptor has also been included at the location of the Noise Monitoring Station (NMS) that was installed at Site 5C. The locations of the points of reception are shown in Figure 1.

The estimated noise levels, at each point of reception, are presented in Table 2 and Table 3. These levels correlate with the levels presented in the NCP, Table A2, for hoe ram and rock drill operations occurring at grade, un-shielded by a barrier, at various distances, and, are consistent with the monitored noise levels at the NMS during periods the hoe ram has been in operation at Site 5C. For example monitored sound levels at the NMS ranged from 93.5 dBA to 113 dBA on the 18th April, 2017, which was the date on which the NMS recorded the highest Lmax for the period from the 11th April to the 25th April, 2017.

As shown in Table 2 and 3, the estimated sound levels, for the two additional operating scenarios analysed, comply with the City of Ottawa specification Section 02482 criteria for the proposed Monday to Friday, 7 am to 7 pm, period of operation. Based on this analysis no changes to the noise control and monitoring recommendations presented in the NCP for Site 5C are required.

It is noted that noise levels will continue to be monitored at Site 5C throughout the whole of the construction process. It is anticipated that noise mitigation measures will likely evolve, guided by the noise monitoring, as the project proceeds in order to ensure that the noise thresholds are met. The details of construction activities cannot be fully anticipated because operations will vary due to local conditions, circumstances and events.

This addendum provides supplementary information to that presented in the NCP. Refer to the "*Noise Control Plan for the Combined Sewage Storage Tunnel Site 5 Stanley Park and Vicinity, City of Ottawa"* prepared by Hugh Williamson Associates, Issued 8th March, 2017 for further details related to the site and surrounding land, the assessment criteria and sound level thresholds, noise control recommendations and noise monitoring locations.

2.0 Assessment Criteria & Sound Level Thresholds

The City of Ottawa *Combined Sewage Storage Tunnel Specification, Section 02482*[1] specifies noise thresholds for on-site operations for various periods of operation and types of noise. The limits are summarized in Table 1.

It is noted that the noise thresholds have been set in terms of Lmax, the maximum sound level occurring over a period of time. The assessment in this report is in terms of Lmax, and, the monitoring which is taking place during construction is also in terms of Lmax.

3.0 Impact Assessment for Additional Equipment Operations and Conditions at Staging Area 5C

Noise levels have been calculated using standard methods which are accepted by the City of Ottawa and the Ministry of Environment and Climate Change. The method is based on an International Standards Organization standard for outdoor sound propagation[2], which is implemented in a software package called CadnaA. The method takes into account the strengths of the noise sources (sound powers) including the following factors.

- Distance attenuation is based on spherical spreading.
- Atmospheric attenuation.
- Ground attenuations, as appropriate.
- Barrier attenuation, buildings for example, as appropriate.
- Heights of points of reception and noise sources.

The two scenario's presented below are in addition to the four scenarios's presented in the NCP for Site 5C. A description of each scenario is as follows:

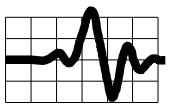
Scenario 1: *Hoe Ram operations occurring on the surface during site preparation at Site 5C – Unshielded (Monday to Friday, 7 am to 7 pm only).*

Scenario 2: *Rock Drill operations occurring on the surface during the construction of the noise barrier at Site 5C – Unshielded (Monday to Friday, 7 am to 7 pm only).*

For each of the scenarios analyzed, five locations of equipment operations were considered corresponding with the equipment located closest to the most impacted noise sensitive land use in each direction from Site 5C.

Based on the operational scenarios discussed above, Lmax sound levels were calculated at all points of reception. Table 2 and Table 3 compare estimated noise levels at each receptor with the applicable sound level limits. It can be seen that the sound level thresholds are met at all receptors for the additional equipment operations and conditions analyzed during the proposed period of operation, Monday to Friday, 7 am to 7 pm (07:00 to 19:00).

Figure 1 shows the locations of equipment operations analyzed with Figures 2.1 to 2.5 and 3.1 to 3.5 showing predicted noise contours, assessed at 4.5 m above grade, i.e. at approximately second storey window height, for all scenarios and locations of operation analyzed.



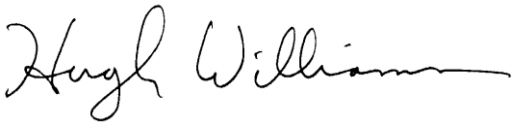
4.0 Summary

An analysis of noise from Hoe Ram operations occurring on the surface at Site 5C during site preparation, and, Rock Drill operations occurring on the surface at Site 5C during the construction of the noise barrier, has been carried out to determine noise impacts at nearby noise sensitive land uses.

It is concluded that with the recommended mitigation measures as detailed in the NCP, noise impacts from operations at Site 5C will be in compliance with the project sound level thresholds, as set out in Section 04282 of the CSST Contract.

Details of the recommended noise control measures are set out in the following sections of the NCP.

- Section 3.4 Noise Control for Operations at 5A and 5B
- Section 4.4 Noise Control for Operations at 5C



Hugh Williamson, Ph.D., P.Eng.
Member, Canadian Acoustical Society, Member, American Society of Heating, Ventilating, Air-conditioning Engineers, ASHRAE

Michael Wells
Registered Architect of NSW, Registration No. 8111, B.Arch (Hons) B.Sc (Arch)
Member, Canadian Acoustical Society

References

1. City of Ottawa, *Combined Sewage Storage Tunnel, Contract No.ISD14-2036, Section 02482 Noise and Vibration*, 2015.

2. International Standards Organization, *Acoustics - Attenuation of Sound during Propagation Outdoors, Part 2: General Method of Calculation*, ISO 9613-2: 1996(E).

Acoustical Terminology

Decibels, dB: Sound levels are expressed in units of decibels, dB. Sound level is 10 times the Logarithm of the squared ratio of the sound pressure over a reference pressure, 20×10^{-6} Pascals.

A-weighting: A-weighting is an internationally standardized frequency weighting which is applied to sound measurements and approximates the variation in sensitivity of human hearing with frequency (pitch).

A-weighted decibels, dBA: For sound levels where A-weighting has been applied, the decibel units are written as dBA. IN this report, all reported sound levels have been A-weighted and hence have units of dBA.

Maximum sound level, Lmax: The maximum sound level occurring over a period of time.

Equivalent sound level, Leq: The Logarithmic Energy Equivalent Continuous Sound Level is the constant sound level over the time period in question, that results in the same total sound energy as the actual time varying sound. Leq must be associated with a time period. Leq is a measure of the total sound energy dose over a specified time period. Essentially, Leq is an energy based average sound level over the period of time.

Noise is unwanted sound.

Noise Barrier / Acoustic Barrier: Means a wall, berm wall/berm combination or similar structure, used as a noise control measure, and high enough to break the line-of-sight between the source and the receptor. Noise barriers must a minimum transmission loss attenuation to be effective.

Tables

Contents:

Table 1: Noise Thresholds

Day	Time	Noise Threshold (Lmax)
Monday – Friday	07:00 – 19:00	130 dBA*
Monday – Friday	19:00 – 22:00	70 dBA
Monday – Friday	22:00 – 07:00	65 dBA
Saturday - Sunday	08:00 – 17:00	70 dBA
Saturday – Sunday	17:00 – 22:00	70 dBA
Saturday - Sunday	22:00 – 08:00	65 dBA

*When operating within 30 m of a classroom or a childcare facility additional conditions apply. Site reconnaissance determined no classrooms or childcare facilities are in close proximity to Site 5C.

Table 2: Summary of Calculated Sound Levels for Scenario 1 – Hoe Ram operations on the surface, No barrier

ID	Description	Hoe Ram at Site 5C Location 1 Lmax (dBA)	Hoe Ram at Site 5C Location 2 Lmax (dBA)	Hoe Ram at Site 5C Location 3 (closest to the noise monitor) Lmax (dBA)	Hoe Ram at Site 5C Location 4 Lmax (dBA)	Hoe Ram at Site 5C Location 5 Lmax (dBA)
POR21_W1	50 Queen Victoria 1st Floor	96.7	95.1	97.8	96.3	104.5
POR21_W2	50 Queen Victoria 2nd Floor	96.6	95.1	97.6	96.2	103.7
POR22_W1	54 Queen Victoria 1st Floor	105.6	97.8	96	91.9	95.3
POR22_W2	54 Queen Victoria 2nd Floor	104.6	97.7	95.9	91.9	95.2
POR23_W1	51 Queen Victoria 1st Floor	95.9	98.2	108.8	98.9	96.6
POR23_W2	51 Queen Victoria 2nd Floor	95.8	98	106.9	98.7	96.5
POR24_W1	55 Queen Victoria 1st Floor	98.8	109.7	99	93.9	94.1
POR24_W2	55 Queen Victoria 2nd Floor	98.6	107.6	98.8	93.8	94
POR25_W1	49 Queen Victoria 1st Floor	91.4	92.6	98.7	108.3	96.1
POR25_W2	49 Queen Victoria 2nd Floor	91.3	92.5	98.5	106.6	96
POR26_W1	136 Stanley Ave 1st Floor	86.9	88.2	90.4	94.2	91.2
POR26_W2	136 Stanley Ave 2nd Floor	86.9	88.2	90.3	94.2	91.1
POR27_W1	132 Stanley Ave 1st Floor	87	86.6	89.2	93.1	92.3
POR27_W2	132 Stanley Ave 2nd Floor	87	86.5	89.1	93	92.2
POR28_W1	58 Queen Victoria 1st Floor	97	95	90.6	88	89.7
POR28_W2	58 Queen Victoria 2nd Floor	96.8	94.9	90.5	88	89.7
POR29_W1	63 Queen Victoria 1st Floor	93	93.8	89.7	87	88.5
POR29_W2	63 Queen Victoria 2nd Floor	92.9	93.7	89.7	87	88.5
POR29_W3	63 Queen Victoria 3rd Floor	92.8	93.6	89.7	87	88.4
POR30_W1	103A River Lane 1st Floor	69.9	68.8	77.5	73.7	72.8
POR30_W2	103A River Lane 2nd Floor	71.7	70.4	77.5	74.6	73.7
POR31_W1*	56 Queen Victoria 1st Floor	101.2	97	92.2	89.6	91.3
POR31_W2*	56 Queen Victoria 2nd Floor	100.8	96.9	92.1	89.5	91.2
POR32_W1*	61 Queen Victoria 1st Floor	96.4	99.1	93.1	89.2	90.8
POR32_W2*	61 Queen Victoria 2nd Floor	96.3	98.9	93.1	89.2	90.8
POR33_W1*	132 Stanley Ave 1st Floor	91.2	90.5	93.7	96.9	100.4
POR34_W1*	50 Queen Victoria 1st Floor	94.2	92.4	96.9	97.2	110.8
POR34_W2*	50 Queen Victoria 2nd Floor	94.1	92.3	96.8	97.1	108.1
POR35_W1*	57 Queen Victoria 1st Floor	98.9	111.3	97.7	93.2	93.6
POR35_W2*	57 Queen Victoria 2nd Floor	98.7	108.5	97.5	93.2	93.5
NMS*	Noise Monitor Station	97.8	98.1	116.3	99.7	98.8

*Additional receptor not included in NCP added this location. Refer to Figure 1.

Table 3: Summary of Calculated Sound Levels for Scenario 2 – Rock Drill operations on the surface, No barrier

ID	Description	Rock Drill at 5C Location 1 Lmax (dBA)	Rock Drill at 5C Location 2 Lmax (dBA)	Rock Drill at 5C Location 3 (closest to the noise monitor) Lmax (dBA)	Rock Drill at 5C Location 4 Lmax (dBA)	Rock Drill at 5C Location 5 Lmax (dBA)
POR21_W1	50 Queen Victoria 1st Floor	96.6	94.8	97.5	95.9	103.9
POR21_W2	50 Queen Victoria 2nd Floor	96.4	94.7	97.3	95.7	102.9
POR22_W1	54 Queen Victoria 1st Floor	105.7	97.5	95.8	91.4	95
POR22_W2	54 Queen Victoria 2nd Floor	104.2	97.3	95.6	91.3	94.9
POR23_W1	51 Queen Victoria 1st Floor	95.6	98	108.5	98.5	96.3
POR23_W2	51 Queen Victoria 2nd Floor	95.5	97.7	106	98.2	96.2
POR24_W1	55 Queen Victoria 1st Floor	98.4	109.4	98.9	93.5	93.7
POR24_W2	55 Queen Victoria 2nd Floor	98.2	106.5	98.5	93.4	93.6
POR25_W1	49 Queen Victoria 1st Floor	90.8	91.9	98.6	108.5	95.9
POR25_W2	49 Queen Victoria 2nd Floor	90.8	91.9	98.2	106	95.7
POR26_W1	136 Stanley Ave 1st Floor	86.5	87.7	90.1	94.3	91.1
POR26_W2	136 Stanley Ave 2nd Floor	86.5	87.7	90	94.2	91.1
POR27_W1	132 Stanley Ave 1st Floor	86.4	86	88.8	93	92.1
POR27_W2	132 Stanley Ave 2nd Floor	86.4	86	88.7	92.9	92
POR28_W1	58 Queen Victoria 1st Floor	96.8	94.9	90.3	87.5	89.4
POR28_W2	58 Queen Victoria 2nd Floor	96.6	94.8	90.2	87.4	89.3
POR29_W1	63 Queen Victoria 1st Floor	92.7	93.6	89.6	86.9	88.1
POR29_W2	63 Queen Victoria 2nd Floor	92.6	93.5	89.5	86.8	88.1
POR29_W3	63 Queen Victoria 3rd Floor	92.4	93.3	89.5	86.8	88
POR30_W1	103A River Lane 1st Floor	68	67	76.9	73.2	73.6
POR30_W2	103A River Lane 2nd Floor	69.1	67.9	76.9	73.2	73.5
POR31_W1*	56 Queen Victoria 1st Floor	101.1	96.8	91.9	89.8	91
POR31_W2*	56 Queen Victoria 2nd Floor	100.5	96.6	91.8	89.8	90.9
POR32_W1*	61 Queen Victoria 1st Floor	96.1	99	92.8	88.7	90.4
POR32_W2*	61 Queen Victoria 2nd Floor	96	98.7	92.7	88.7	90.3
POR33_W1*	132 Stanley Ave 1st Floor	91.1	90.4	93.7	96.7	100.4
POR34_W1*	50 Queen Victoria 1st Floor	94	93.3	96.7	96.9	110.1
POR34_W2*	50 Queen Victoria 2nd Floor	93.8	93.3	96.5	96.7	106.8
POR35_W1*	57 Queen Victoria 1st Floor	98.6	111	97.5	92.8	93.2
POR35_W2*	57 Queen Victoria 2nd Floor	98.3	107.3	97.3	92.7	93.1
NMS*	Noise Monitor Station	97.5	97.9	114.6	99.3	98.6

*Additional receptor not included in NCP added this location. Refer to Figure 1.

Figures

Contents:

Figure 1: Staging Area 5C site plan, showing Points of Reception (POR's) and location of operations analyzed

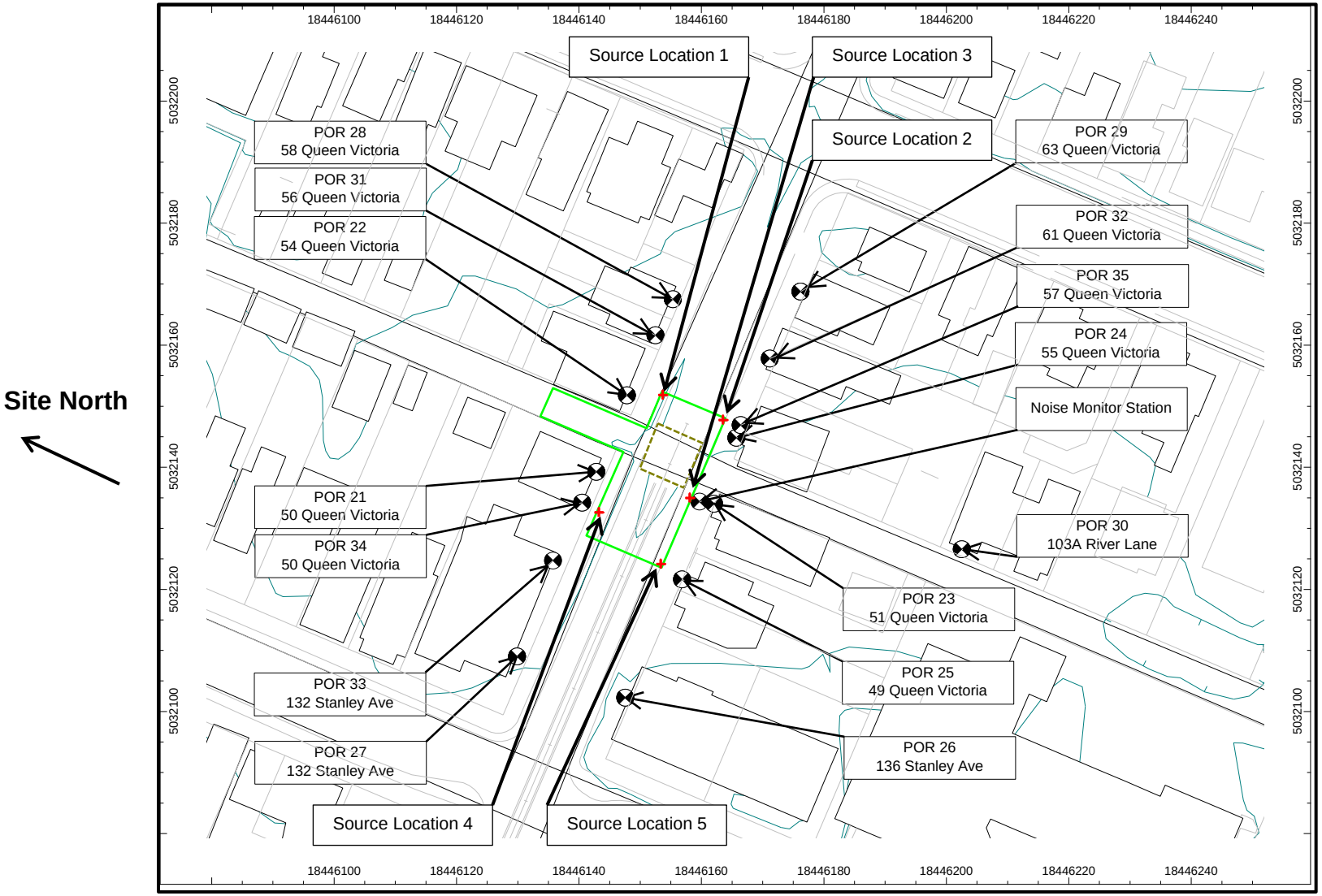
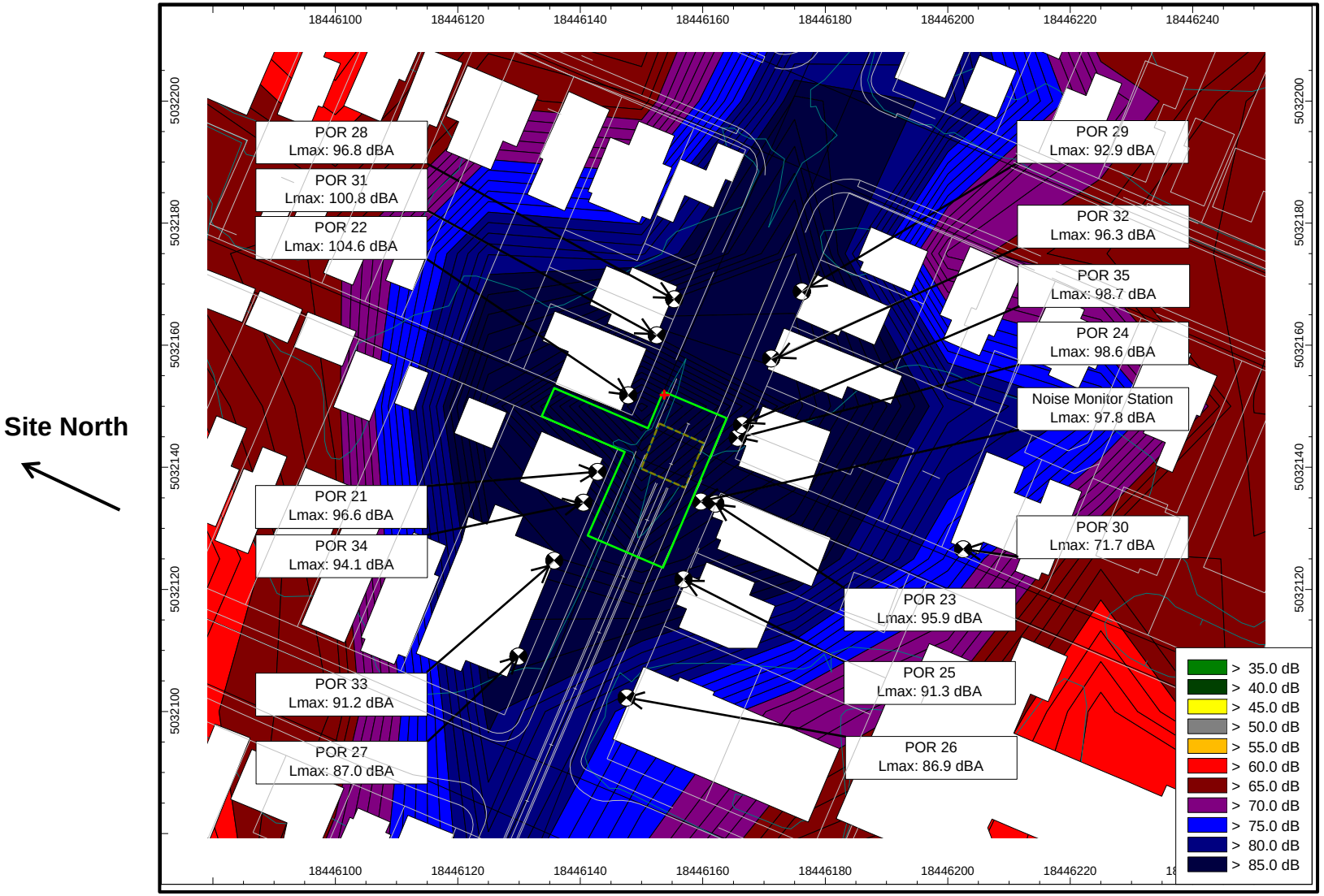


Figure 2.1: Scenario 1: Lmax Noise Contours, Hoe Ramming at 5C Location 1



Site North

Figure 2.2: Scenario 1: Lmax Noise Contours, Hoe Ramming at 5C Location 2

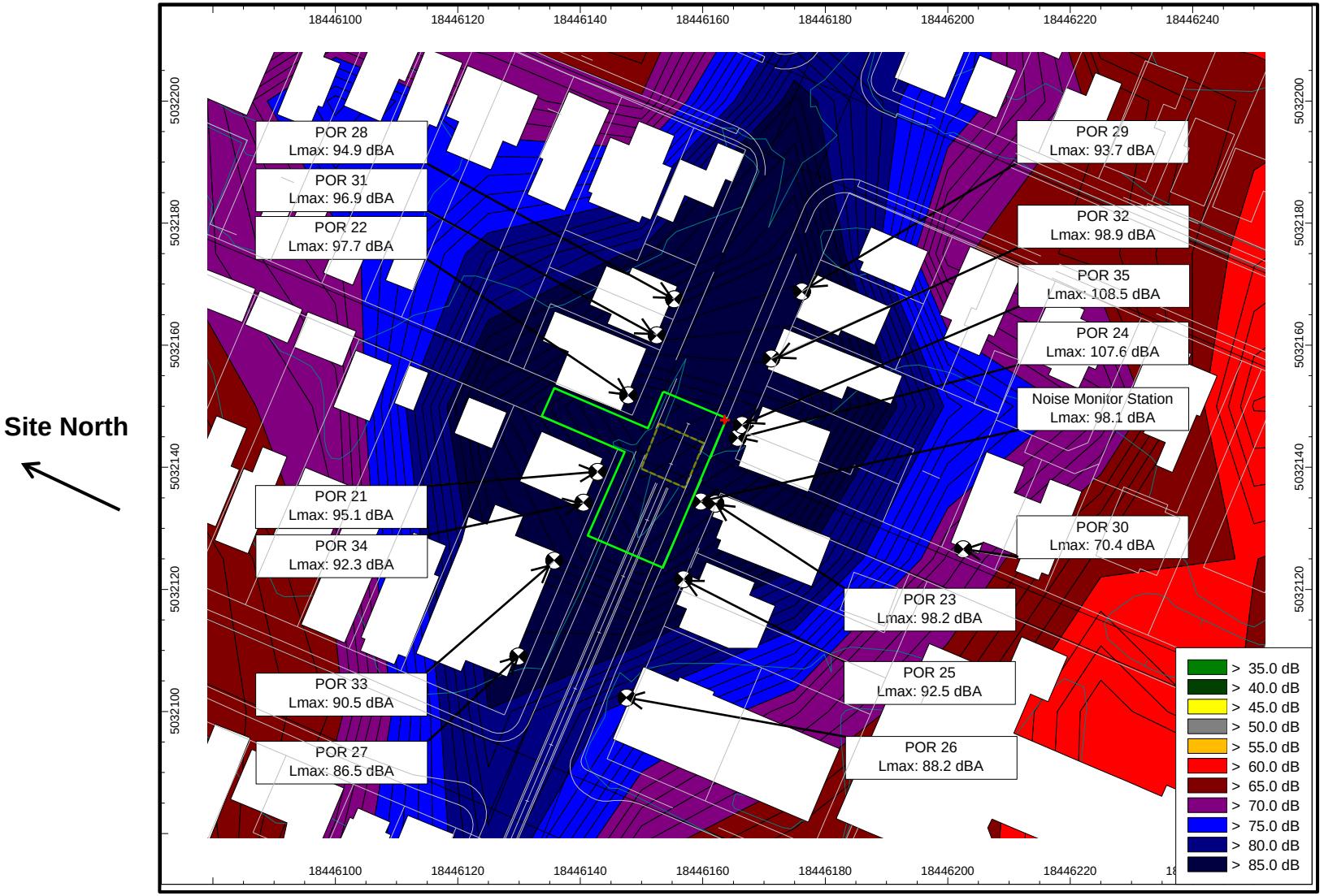


Figure 2.3: Scenario 1: Lmax Noise Contours, Hoe Ramming at 5C Location 3

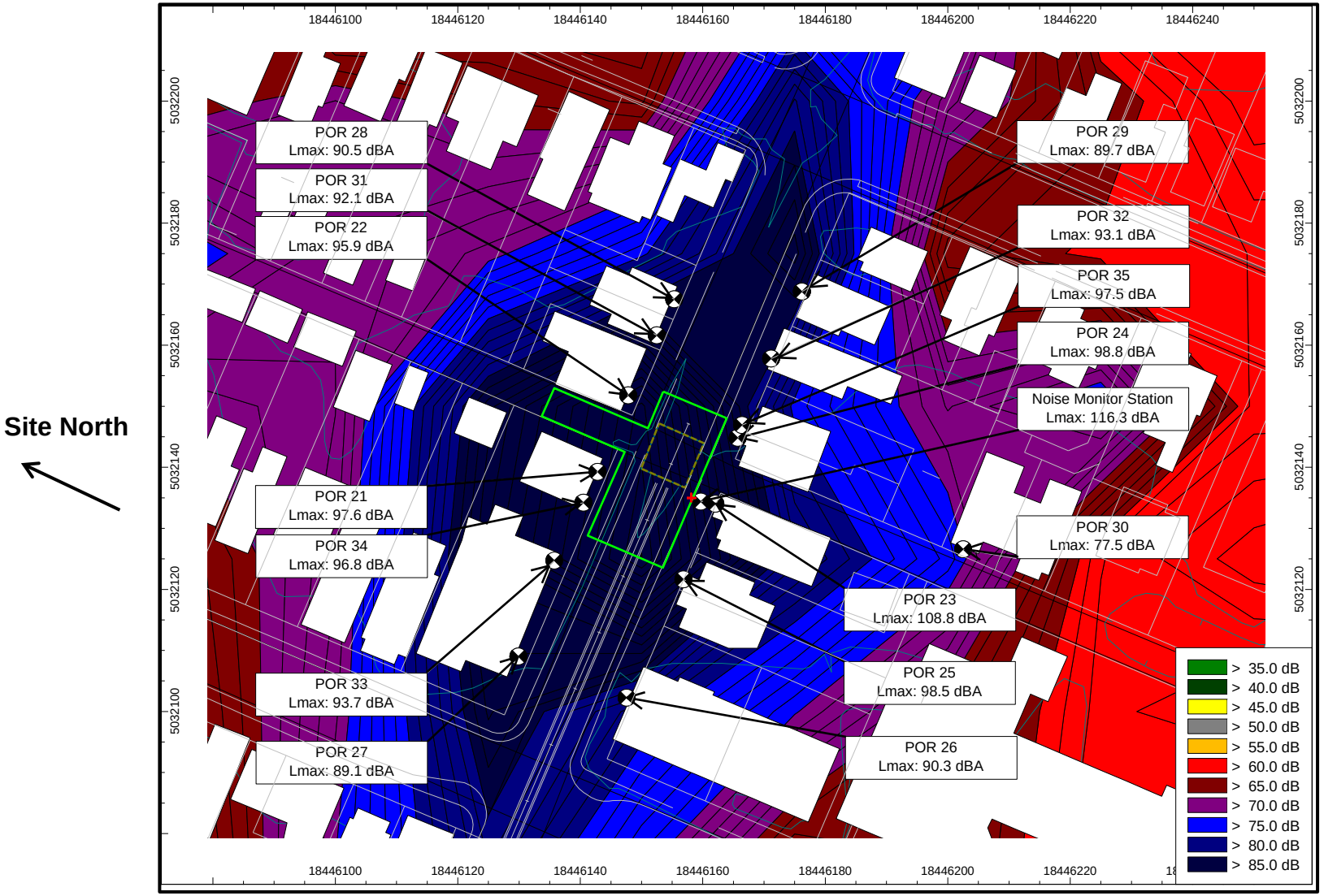


Figure 2.4: Scenario 1: Lmax Noise Contours, Hoe Ramming at 5C Location 4

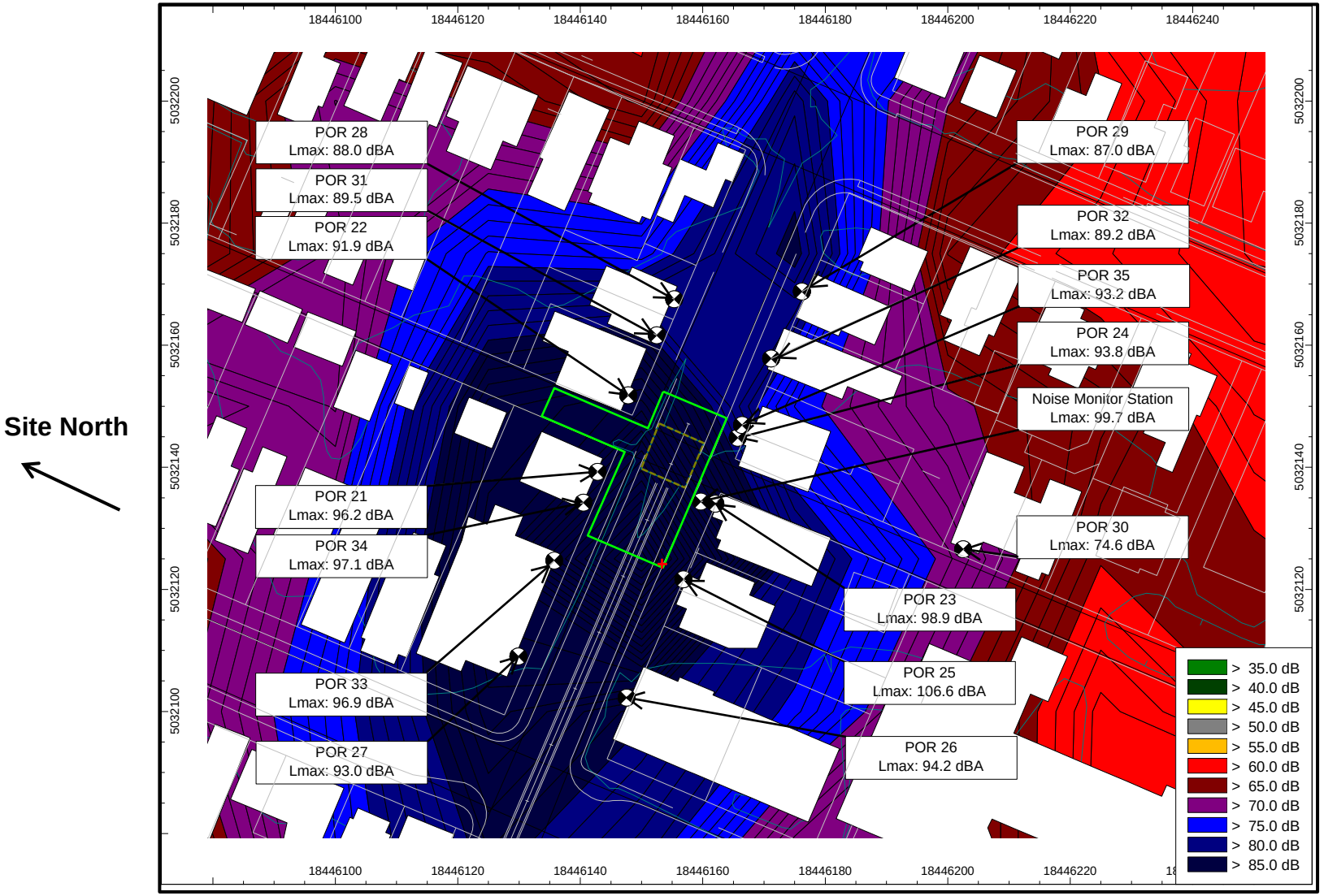


Figure 2.5: Scenario 1: Lmax Noise Contours, Hoe Ramming at 5C Location 5

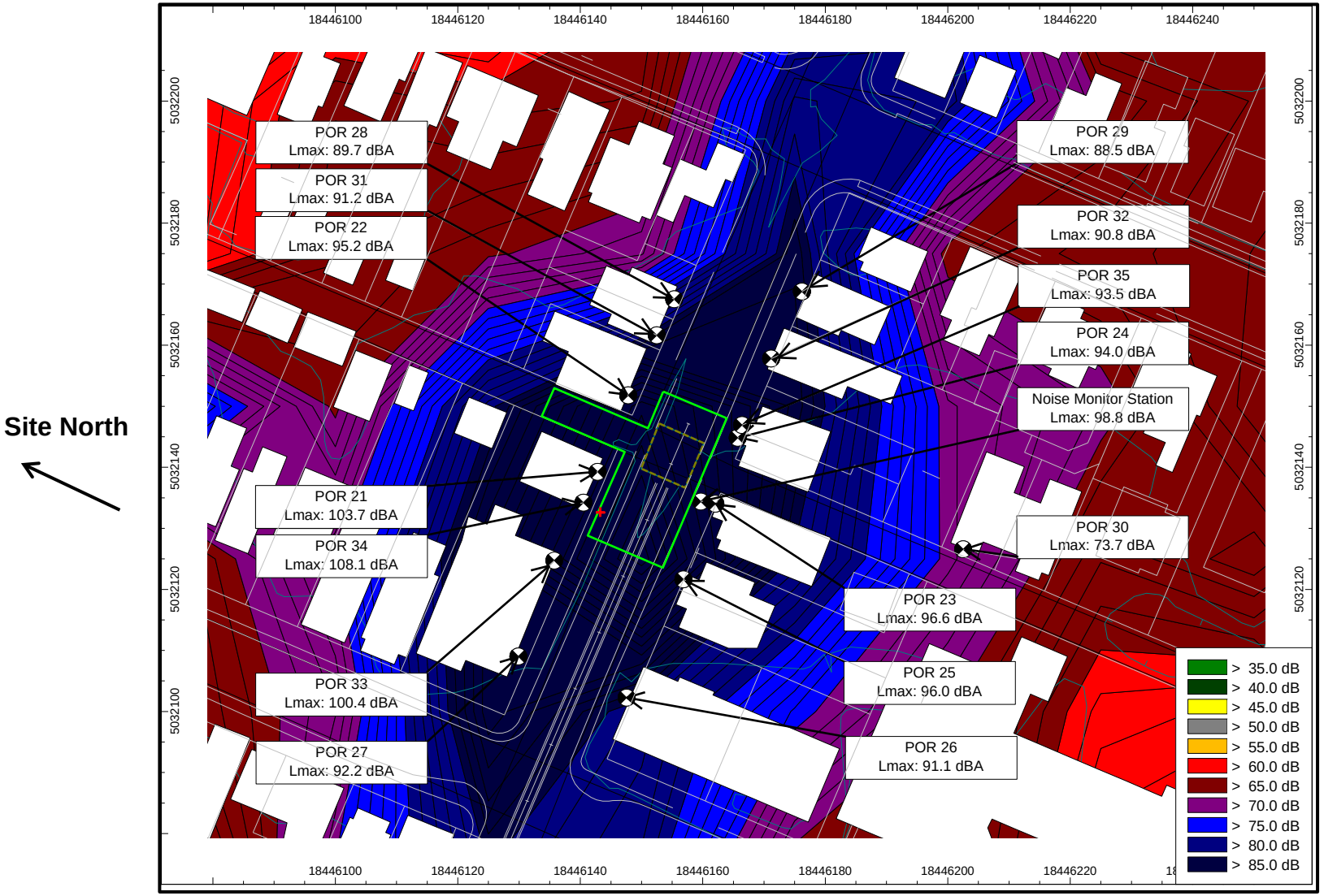


Figure 3.1: Scenario 2: Lmax Noise Contours, Rock Drill at 5C Location 1

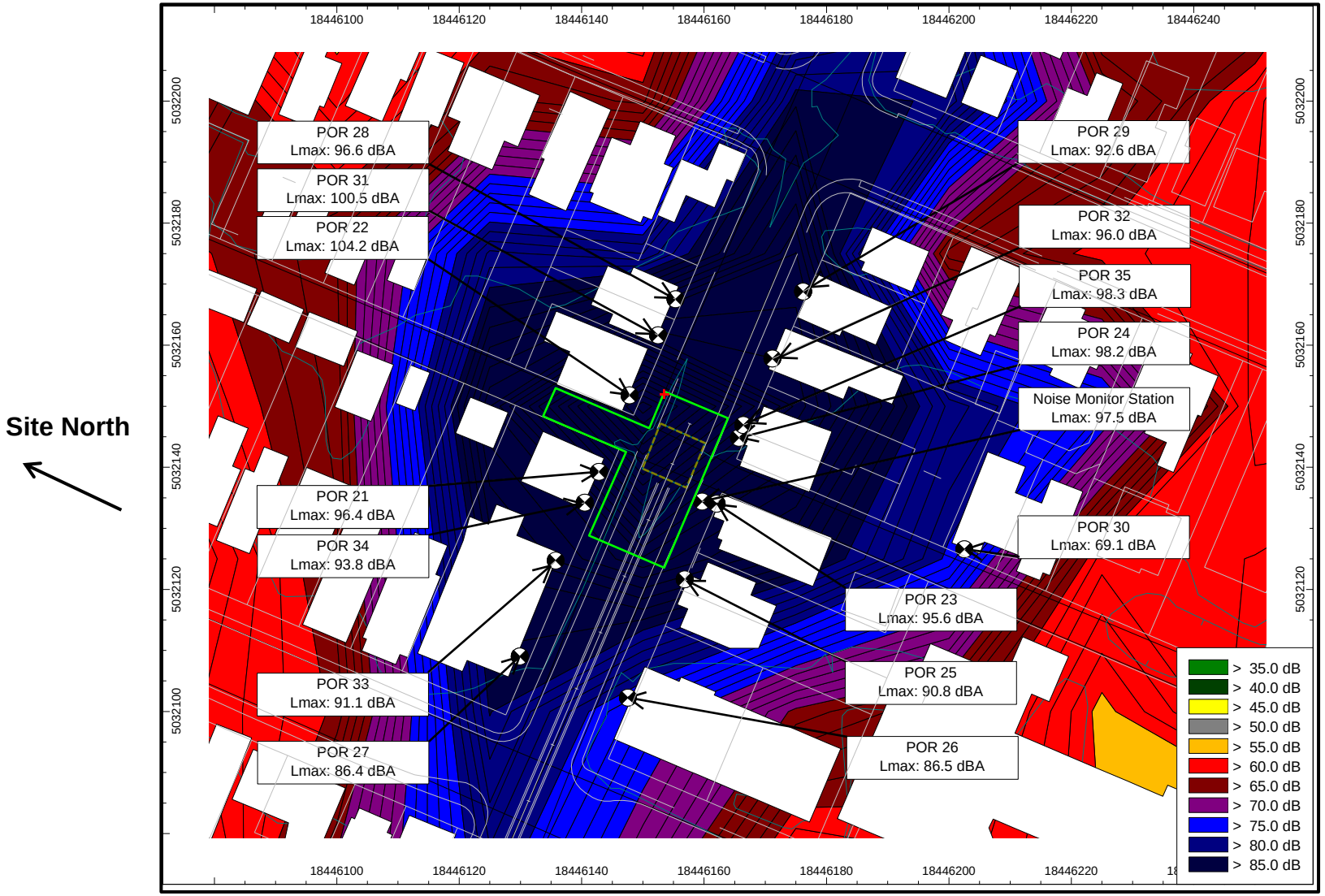


Figure 3.2: Scenario 2: Lmax Noise Contours, Rock Drill at 5C Location 2

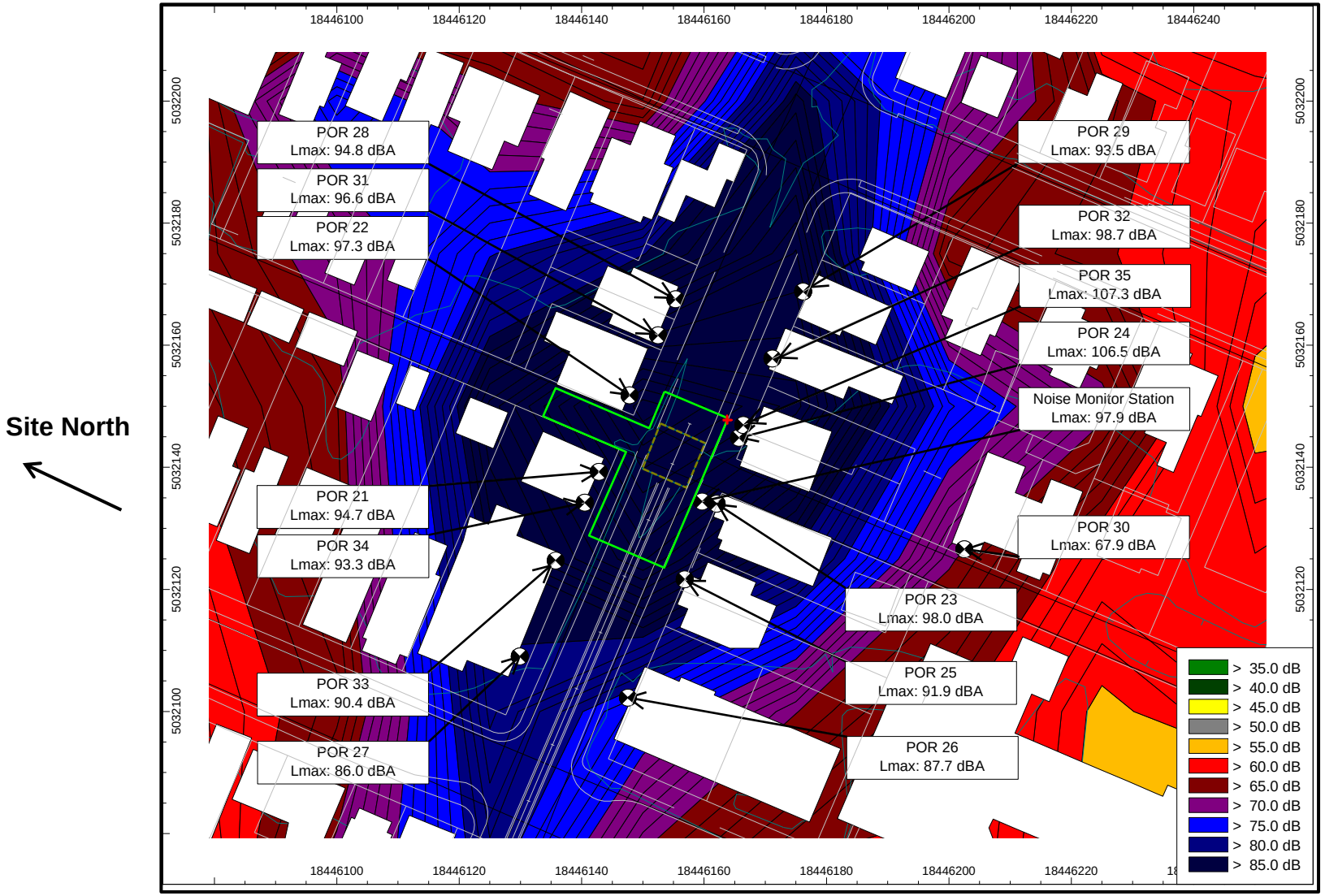


Figure 3.3: Scenario 2 Lmax Noise Contours, Rock Drill at 5C Location 3

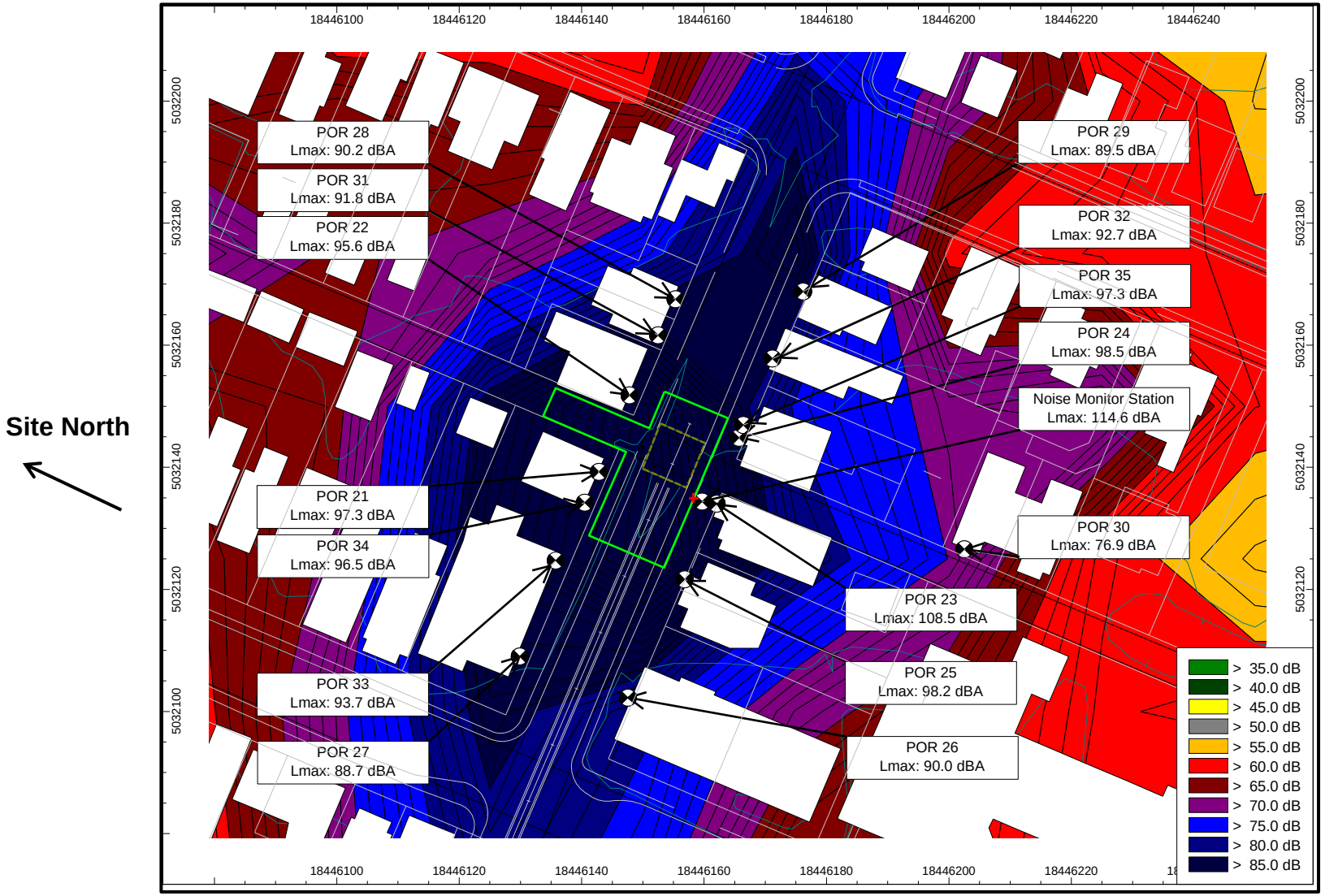


Figure 3.4: Scenario 2: Lmax Noise Contours, Rock Drill at 5C Location 4

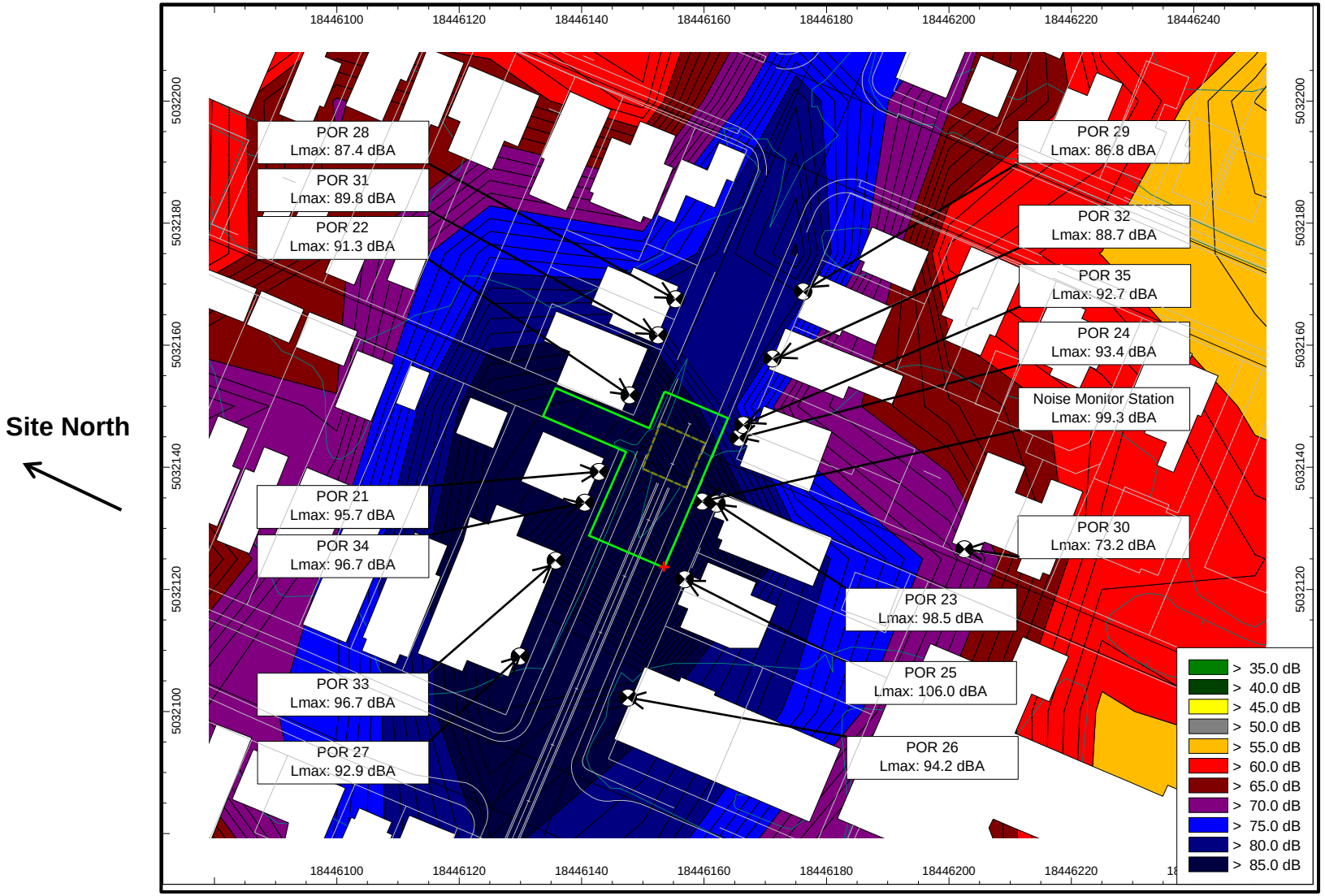
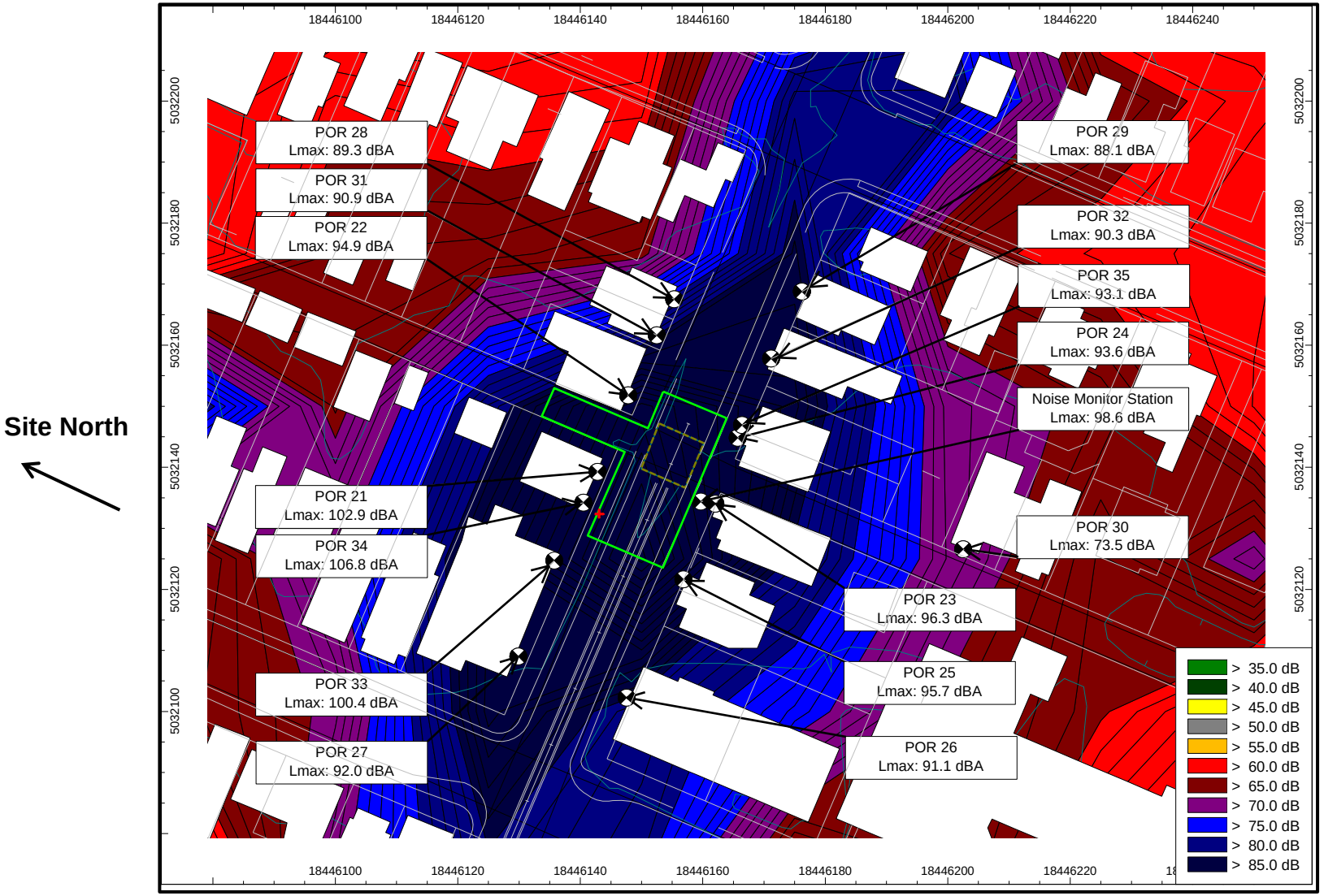


Figure 3.5: Scenario 2: Lmax Noise Contours, Rock Drill at 5C Location 5



HUGH WILLIAMSON ASSOCIATES INC.
Ottawa, Ontario, Canada

RESUMÉ: Dr. HUGH WILLIAMSON, P.Eng.

QUALIFICATIONS:

Ph.D. Mechanical Engineering, University of New South Wales, 1972

B.Sc. Mechanical Engineering, (with Distinction), University of Alberta, 1967

Member, Professional Engineers, Ontario

Member, Canadian Acoustical Association

Member, American Society of Heating, Refrigeration and Air-conditioning Engineers

KEY COMPETENCIES:

- Environmental noise and vibration assessments, Environmental Compliance Approval (ECA). Noise assessment for land use planning
- Architectural and building acoustics, acoustics of office spaces, meeting rooms, auditoriums and studios, noise and vibration control of building mechanical services.
- Industrial noise and vibration assessment and control.
- Transportation noise and vibration.

PROFESSIONAL EXPERIENCE:

Hugh Williamson is a professional engineer with many years of experience in the measurement, analysis and control of noise and vibration. Hugh Williamson Associates was incorporated in 1997 and provides consulting services in architectural, building, industrial, transportation and environmental acoustics and vibration. Clients include architects, engineering firms, industrial firms and government departments. Prior to establishing Hugh Williamson Associates, his career included extensive periods in industry as well as university level research and teaching. He is a former Director of the Acoustics and Vibration Unit at the Australian Defence Force Academy. He has published over 50 engineering and scientific papers and has been an invited speaker on noise and vibration at national and international conferences. He has more than 20 years of experience as a consultant.

CLIENT LIST:

Hugh Williamson Associates provides consulting services to large and small clients including: National Research Council, National Capital Commission, J. L. Richards & Associates, Barry Padolsky Associates, HOK Urbana Architects, Genivar, Nasittuq Corporation, PWGSC, R. W. Tomlinson, Geo. Tackaberry Construction and Miller Paving.

Postal Address: PO Box 74056, RPO Beechwood, Ottawa, Ontario, K1M 2H9, Canada
Phone/Fax: (613) 747 0983, Email: hugh@hwacoustics.ca, http://www.hwacoustics.ca

RESUMÉ: MICHAEL WELLS

QUALIFICATIONS:

Registered Architect of NSW, Registration Number: 8111

B. Architecture (Hons), University of Sydney, 2002

B.Sc. Architecture, University of Sydney, 1999

Member, Canadian Acoustical Association

KEY COMPETENCIES:

- Environmental noise and vibration assessments, Environmental Compliance Approval (ECA). Noise assessment for land use planning.
- Architectural and building acoustics, acoustics of office spaces, meeting rooms, auditoriums and studios, noise and vibration control of building mechanical services.
- Industrial noise and vibration assessment and control.
- Transportation noise and vibration.
- Design services including sketch design, design development (development / permit applications), contract documents, tendering and contract administration.

PROFESSIONAL EXPERIENCE:

Michael Wells is a professional Architect registered in NSW with many years of experience in the Architectural and Construction industries. With key competencies in measurement, analysis and control of noise and vibration, Michael Wells joined Hugh Williamson Associates in 2012 and provides consulting services in architectural, building, industrial, transportation and environmental acoustics and vibration. Clients include architects, engineering firms, industrial firms and government departments. Prior to joining Hugh Williamson Associates, his career includes the founding of Michael Wells Architect in Sydney Australia which specialized in the design of institutional, commercial and residential projects. He is a Director of Architectural Workshops Australia and Vision Blue Pty Ltd. He has more than 10 years of experience as a consultant.

CLIENT LIST:

Hugh Williamson Associates provides consulting services to large and small clients including: National Research Council, National Capital Commission, J. L. Richards & Associates, Barry Padolsky Associates, HOK Urbana Architects, Genivar, Nasittuq Corporation, PWGSC, R. W. Tomlinson, Geo. Tackaberry Construction and Miller Paving.

Postal Address: PO Box 74056, RPO Beechwood, Ottawa, Ontario, K1M 2H9, Canada
Phone/Fax: (613) 747 0983, Email: michael@hwacoustics.ca, http://www.hwacoustics.ca