forum acusticum 2026
8-12 September · Graz, Austria

FROM SOUNDWALKS TO AURALISATION: A PARTICIPATORY WORKFLOW FOR BIOPHILIC SOUNDSCAPE DESIGN IN URBAN GREEN SPACES USING CITY DITTY

P. Kogan[a], L. Fuentes[a], R. Yanaky[b], D. Verdugo[a], P. Hidalgo[a], I. Saavedra[a], J. Monsalve[a], A. Vásquez[c], A. Salinas[a], B. Vega[a], J. Illanes[a], L. Estévez-Mauriz[d], E. Bild[b] and C. Guastavino[b]

[a]*ChucaoLab, Dept. of Sound, Faculty of Arts, University of Chile, Compania 1264, 8320000 Santiago, Chile*

[b]*McGill University, Sounds in the City, School of Information Studies, Montreal, Canada H3A 1X1*

[c]*Institute of Social Sciences, Universidad de O'Higgins, Av. Libertador Gral. Bernardo O'Higgins 611, 8320000 Rancagua, Chile*

[d]*Department of Applied Chemistry and Physics, Universidad de León, Campus de Vegazana s/n, 24071 León, Spain*

Abstract

This paper presents a participatory workflow for biophilic soundscape design in urban green spaces, applied to a 3.16-ha sector of Parque O'Higgins in Santiago, Chile, currently occupied by the amusement park Fantasilandia. The complete workflow links baseline diagnosis, local preparation of City Ditty, an interdisciplinary workshop and design competition, post-competition auralisation, laboratory perceptual assessment, optimisation, validation, and dissemination. Previously reported preparatory stages are summarised for self-containment; the main focus is the workshop, four interdisciplinary proposals, expert jury review, technical adaptation, and auralisation. The workshop combined theoretical sessions, site and laboratory visits, team formation, four guided practical sessions, and a one-month independent development period with weekly feedback. Five positions were auralised per proposal, producing twenty auralisations assessed with 48 participants using the ISO 12913 affective attributes and overall soundscape assessment, together with the Green Soundscape Index. Results are not reported here. The documented sequence offers a transferable structure for soundscape-informed urban green-space design.

Keywords: *biophilic soundscape design, auralisation, participatory design, urban green spaces, City Ditty*

1. Introduction

Soundscape design is increasingly recognised as relevant to the quality of urban green spaces, yet its integration into planning and design processes remains limited by methodological and technological gaps. Conventional approaches to environmental sound in urban projects still tend to focus on noise control, while soundscape approaches invite a broader consideration of sound as a perceptual, experiential, social, ecological, and design-related dimension [1], [2]. This is especially relevant in urban green spaces, where the auditory environment may contribute not only to the spatial experience but also to well-being and public health [3], [4].

This work documents a pilot workflow developed within the FONDECYT project "Biophilic soundscape design in urban green spaces through immersive technologies". It explores how natural sound sources and immersive auralisation tools can inform early urban green-space design before any implementation decision. The paper connects completed, ongoing, and planned stages while focusing on those not previously described in detail.

The contribution builds on two Inter-Noise 2025 papers: one presented the broader methodological framework and baseline soundscape data collection [6], and the other documented the local preparation of City Ditty and its audio, visual, and spatial resources [7]. These stages are summarised here; the main contribution is the subsequent participatory design, post-competition auralisation, and laboratory evaluation.

2. Workflow Overview

The complete project workflow is shown in Figure 1. The preparatory stages—baseline soundscape and contextual data collection, local sound-source recording and preparation of City Ditty, and baseline stimulus preparation and perceptual evaluation—were previously reported [6], [7] and are summarised here for self-containment. The present paper documents the workshop and design competition, expert jury evaluation, post-competition adaptation and auralisation, and laboratory-based perceptual evaluation. Ongoing optimisation and the subsequent final validation and dissemination stages are

***Corresponding author**: pablo.kogan@uchile.cl*

included in the figure to preserve the continuity of the overall project, but are not reported here.

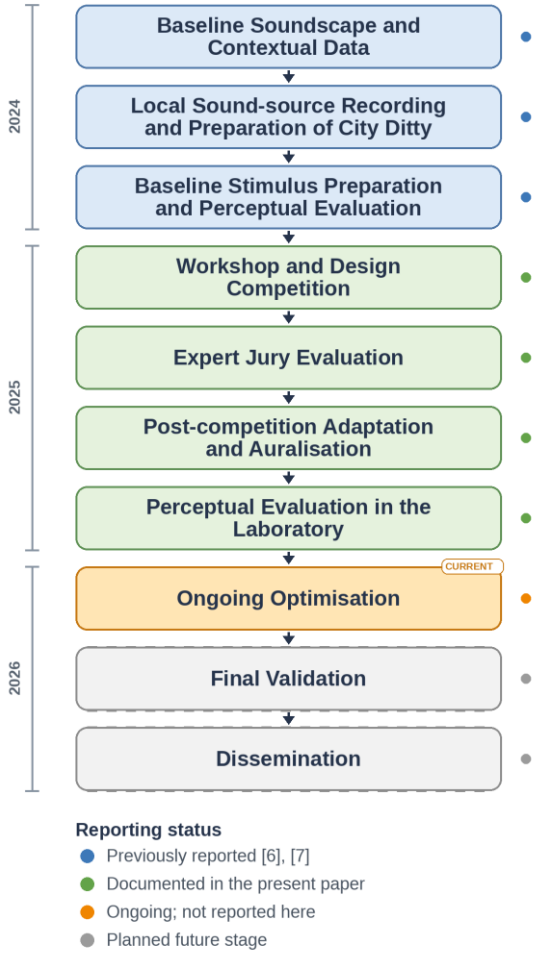

Figure 1. Complete project workflow and reporting status: blue, previously reported; green, documented here; orange, ongoing; grey, planned.

3. Study Site and Project Scope

The case study is a 3.16-ha sector of Fantasilandia within Parque O'Higgins, central Santiago. It corresponds to approximately half of the amusement-park site and was deliberately delimited at the traffic-exposed corner adjoining Tupper and Beauchef streets. Its flat, continuous, moderate-scale surface permits internal zoning and spatial differentiation while retaining a demanding perimeter condition. The research-led pilot is independent of a municipal commission and is not an approved design or implementation plan, although it may inform future discussions about the site.

Although the project does not seek to classify the proposal formally as a Health Restoration Soundscape (HeReS), the brief and evaluation engage with three HeReS conditions [4]: naturalness (C1) through predominantly natural cover; perceived source balance (C3) through the Green Soundscape Index; and soundscape assessment (C4) through overall evaluation and the ISO pleasantness-eventfulness model. A companion paper on the larger Quinta Normal Park [5] provides context for considering scale, form, zoning, and buffering in this smaller traffic-exposed area.

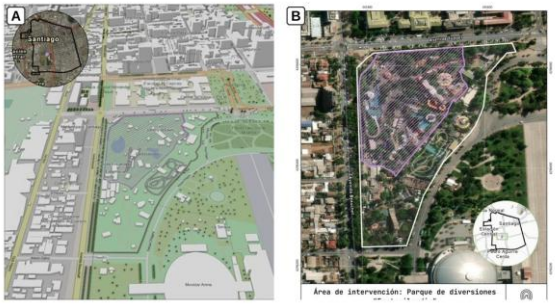

Figure 2. Study site and intervention area in the Fantasilandia sector of Parque O'Higgins, Santiago, Chile.

4. Previously Reported Preparatory Stages

4.1 Baseline Soundscape and Contextual Data

Baseline diagnosis combined a community soundwalk and multidimensional data at five listening stations: perceptual assessments, ambisonic and complementary audio recordings, acoustic measurements, 360-degree video, and photographs [1], [6]. Additional inputs included community perceptions, perimeter traffic and sound levels, GIS data, and information on vegetation, fauna, water, and other site conditions. These supported simulation and the competition brief; detailed protocols and results are outside this paper's scope.

4.2 Local Sound-source Recording and Preparation of City Ditty

City Ditty is an interactive soundscape design and auralisation tool developed at McGill University as an immersive soundscape sketchpad for professionals of the built environment [9], [10]. For the Chilean case, a local implementation used a 3D model of the study area, GIS-based maps and visual assets, an ambisonic room-tone recording, and local audio assets [7]. Unity prefabs and Wwise soundbanks connected these elements to City Ditty's playback and visualisation functions and implemented source levels and propagation curves. ChucaoLab recorded local bird species, water sounds, wind interacting with trees, and other site-relevant material; the audio and corresponding visual or interaction assets were prepared in Wwise and Unity and integrated with the City Ditty designer.

4.3 Baseline Stimulus Preparation and Perceptual Evaluation

Field recordings and baseline auralisations were prepared at the same five listening stations and evaluated in a first laboratory listening test, providing the perceptual reference for the subsequent design stages [6]. This previously reported stage is included here only to preserve continuity across the workflow.

5. Workshop and Design Competition

5.1 Workshop Structure and Team Formation

The workshop "Soundscape and Sustainability in Urban Green Areas" was organised by ChucaoLab at the University of Chile from June to August 2025. It combined a theoretical phase on socio-cultural valuation, planning, sustainability, ecology, landscape design, health, equity, public health, and soundscape with a practical proposal-development phase. A guided park visit, laboratory visit, and design-team soundwalk linked this background to the applied process.

The call included undergraduate and postgraduate students and professionals from sound, architecture and urbanism, social and environmental sciences, and related fields. Disciplinary and status-based quotas were used. After integration and disciplinary self-identification activities, 35 participants formed five teams of five to seven members, balanced as far as possible by discipline, status, and size. One team did not submit by the deadline, leaving four proposals for competition and auralisation.

5.2 Design Brief, Supporting Materials and Evaluation Criteria

The brief asked teams to design a sustainable, interdisciplinary, biophilic park for the 3.16-ha area, shifting a technologically dominated soundscape towards perceptual predominance of natural sounds. Requirements included at least 90% natural ground cover, adapted from HeReS naturalness [4]; reduced perimeter traffic impact; no amplified sound technologies; retention of relevant pre-existing elements; acoustically differentiated zones; and development of five predefined listening positions.

Teams received planimetry and cartography, perimeter sound and traffic measurements, community soundwalk responses, ecological field information, and GIS indicators. Boundary data addressed the Tupper and Beauchef exposure, also considered in related urban-park soundscape research [8].

Outputs comprised two 90 × 90 cm boards, a four-minute audiovisual file, a Unity project or asset set, and an oral presentation. They covered diagnosis, conceptual foundation, ecological and urban structure, 1:2000 and 1:500 plans, programme and zoning, acoustically differentiated areas, biophilic soundscape strategies, and the five positions. The brief announced five criteria: interdisciplinary diagnosis; conceptual foundation and strategies; programme and spatial proposal; soundscape and biophilic design; and representation and communication.

5.3 Proposal Development Process

The practical phase comprised four guided in-person sessions. The first introduced the brief and interdisciplinary diagnosis; the second developed concept, programme, access, circulation, zoning, and the five positions. Maps, diagrams, sketches, and field evidence were translated into spatial and soundscape requirements.

The third and fourth sessions transferred proposals into Unity and connected them with soundscape simulation. Participants used Unity 2021.3.0f1, the Built-in Render Pipeline, and a base project with the site and intervention polygons. FBX and OBJ assets had to preserve scale, orientation, layers, and tags.

A City Ditty demonstration introduced the audio engine and virtual space, while guided work connected soundscape concepts with materials, vegetation, spatial configuration, and the five positions. The design-team soundwalk and laboratory visit further linked field listening and technical tools to the proposals.

After the in-person sessions, teams continued independently for one month, allowing reflection and proposal maturation. Weekly synchronous feedback and an online consultation channel provided support, coordinated by ChucaoLab monitors and technical-scientific advisors.

Figure 3. Workshop and competition process: (A) initial guided site visit; (B) design-team soundwalk; (C) collaborative spatial design; (D) City Ditty demonstration; (E) Unity/City Ditty-based work; and (F) final presentation of a proposal.

5.4 Final Presentations and Collective Closing Session

After uploading their materials, teams presented publicly (Figure 3F) using boards, slides, and/or audiovisual content. Jurors asked clarifying questions, but formal scoring occurred later from the submitted deliverables. The session allowed teams to view one another's completed proposals and close the collective process; all presenting teams received a certificate and a small token.

5.5 Expert Jury Evaluation

Formal assessment followed the closing session and was based on the deliverables. Four external jurors represented academic, public-management, and private-sector perspectives and complementary disciplines, with stronger representation from planning, architecture, urbanism, and landscape, alongside social-science and soundscape expertise. A structured form recorded scores and internal and team-facing comments. The jury assessed interdisciplinary diagnosis (10%), conceptual foundation and strategies (10%), programme and spatial proposal (20%), and representation and communication (10%), together contributing 50% of the overall score. The remaining 50%, corresponding to soundscape and biophilic design, came from the laboratory tests in Section 7. Outcomes are not reported here.

6. Post-competition Adaptation and Auralisation

After the competition, the project team reviewed and adapted the proposals for City Ditty, transforming visual and sonic elements into operational assets. Some materials required simplification or optimisation before incorporation into Unity/City Ditty. Architects and sound engineers supported this work in coordination with the City Ditty designer at McGill University.

This was a second City Ditty development phase. The baseline environment and Chilean sound assets had been prepared before the workshop; afterwards, proposal-specific visual and sonic elements were integrated. ChucaoLab then assembled the four proposed parks in City Ditty according to each team's design intentions.

Approximately 60 team-designed Unity prefabs were integrated into City Ditty and configured for its interaction and playback requirements. Irregular objects required offset sound-source positions, and attenuation was delayed for very large objects. The existing birdhouse marker was expanded into variants associated with local recordings; these are visual and sonic proxies, not literal ecological prescriptions. In parallel, a ChucaoLab natural-resources specialist related target birds to local vegetation structure, water and soil conditions, and interspecific compatibility, prioritising native vegetation and retention of existing native plants. This ecological layer informs optimisation.

For each proposal, the same five stations used in the community and design-team soundwalks were auralised, yielding 20 auralisations. Retained from baseline acquisition through workshop tasks, prediction, and perceptual evaluation, they provided a common longitudinal basis for comparison, although teams designed the park as a whole.

7. Perceptual Evaluation in the Laboratory

The four proposals were evaluated with 48 participants in an acoustically isolated booth. Binaural stimuli were reproduced through circumaural headphones, randomly and without visual information or proposal identification. Participants responded on a tablet linked to the control computer, allowing incoming data to be monitored graphically in real time.

The ISO 12913-based protocol comprised the eight affective attributes used to derive pleasantness and eventfulness and the overall soundscape assessment [11], together with the Green Soundscape Index [3]. Sessions lasted about 45 minutes. Max/MSP controlled playback and response monitoring; playback level was set through a preliminary subjective comfort adjustment with the loudest stimulus and a small ChucaoLab group. The test informed optimisation; results are not reported here.

8. Ongoing Optimisation

The current optimisation is conducted by an interdisciplinary ChucaoLab team, combining soundscape research, acoustics and acoustic modelling, sound engineering and audio production, spatial and architectural design, and environmental sciences, with targeted external feedback. Competition, jury, and perceptual evidence are used to develop strong strategies rather than treat one submission as final. Smaller listening tests support successive design and auralisation adjustments.

9. Final Validation and Dissemination

After optimisation, final validation is planned with a larger sample. Dissemination is expected to include a headset-based 360° audiovisual comparison of baseline and projected scenarios, a multichannel or ambisonic spatial-audio presentation, a policy brief, and a website for professional, institutional, and public audiences.

10. Conclusions

By connecting field evidence, interdisciplinary design, expert review, auralisation, and perceptual assessment, the workflow demonstrates a practical way to incorporate soundscape during early design and evaluation. It enabled deliberate listening, translation of auditory and contextual evidence into spatial proposals, comparison of alternatives, and iterative refinement, foregrounding sound's contribution to the experience and potential use of public space.

The workflow is transferable beyond a single park: it brings soundscape into planning early enough to influence process and outputs while sustaining communication among researchers, designers, institutions, and future users. This paper documents the process rather than outcomes; later work will report comparative evaluation, optimisation, and final validation.

11. Acknowledgments

This project was supported by ANID/FONDECYT No. 11240852 and by the Department of Sound, Faculty of Arts, University of Chile. The work was developed in collaboration with the Multimodal Interaction Lab / Sounds in the City at McGill University, Sustentabilidad UChile, PROMA, and EneAS. We thank Paola Velásquez, Paula Urrutia, Andrea de la Cerda, Karla Pino, Camila Villavicencio, Sofía Mardones, Francisco Riquelme, Joaquín Vallejo, Claudia Rojas, Rocío Riquelme, Alejandro Pantoja, Alicia Trincado, Guillermo Eisner, Verónica Vargas, Ignacio Villagra, and each workshop participant.

12. References

[1] P. Kogan, B. Turra, J. P. Arenas, and M. Hinalaf, "A comprehensive methodology for the multidimensional and synchronic data collecting in soundscape," Sci. Total Environ., vol. 580, pp. 1068–1077, 2017.

[2] E. Bild, M. Coler, K. Pfeffer, and L. Bertolini, "Considering sound in planning and designing public spaces: A review of theory and applications and a proposed framework for integrating research and practice," J. Plan. Lit., vol. 31, no. 4, pp. 419–434, 2016.

[3] P. Kogan, J. P. Arenas, F. Bermejo, M. Hinalaf, and B. Turra, "A Green Soundscape Index (GSI): The potential of assessing the perceived balance between natural sound and traffic noise," Sci. Total Environ., vol. 642, pp. 463–472, 2018.

[4] P. Kogan, T. Gale, J. P. Arenas, and C. Arias, "Development and application of practical criteria for the recognition of potential Health Restoration Soundscapes (HeReS) in urban greenspaces," Sci. Total Environ., vol. 793, 148541, 2021.

[5] P. Kogan, F. Riquelme, C. A. Manzano, I. Saavedra, A. Vásquez, and M. L. Felippe, "Learning from the application of criteria for recognising potential Health Restoration Soundscapes (HeReS) in urban parks: Towards soundscape-informed design," in Proc. Forum Acusticum 2026, Graz, Austria, 2026.

[6] P. Kogan et al., "Biophilic soundscape design in urban greenspaces," in Proc. INTER-NOISE 2025, São Paulo, Brazil, 2025.

[7] R. Yanaky et al., "Application of the City Ditty soundscape tool in an interdisciplinary urban park design competition," in Proc. INTER-NOISE 2025, São Paulo, Brazil, 2025.

[8] N. Imani, S. Lotfi, and C. Guastavino, "Sense of Place (SoP) and soundscapes in an urban park in Shiraz: Could the S in SoP stand for sound too?," Sustainability, vol. 18, art. 2353, 2026.

[9] R. Yanaky, D. Tyler, and C. Guastavino, "City Ditty: An immersive soundscape sketchpad for professionals of the built environment," Appl. Sci., vol. 13, no. 3, 2023.

[10] R. Yanaky and C. Guastavino, "Translating soundscapes into practice using virtual reality: City makers' insights on interactive soundscape simulation," in Proc. Forum Acusticum 2026, Graz, Austria, 2026.

[11] ISO/TS 12913-2:2018, Acoustics — Soundscape — Part 2: Data collection and reporting requirements, ISO, 2018.